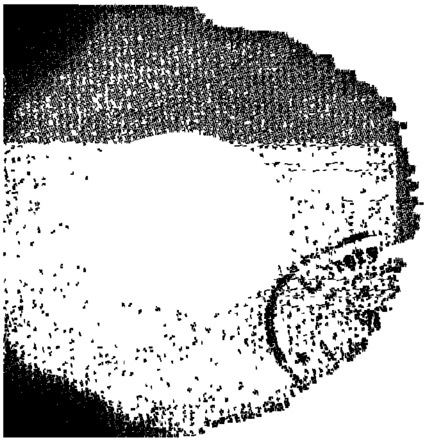

SCHOOL SCIENCE

VOL XVIII NO 1 March 1980

SCHOOL SCIENCE is a quarterly journal published by the National Council of Educational Research and Training. Intended to serve teachers and students in schools with the recent developments in science and science methodology, the journal aims to serve as a forum for the exchange of experience in science education and science projects. Articles covering these aims and objectives are invited. Manuscripts, including legends for illustrations, charts, graphs, etc, should be neatly typed double-spaced on uniformly-sized paper, and sent to the Editor, SCHOOL SCIENCE. Department of Education in Science and Mathematics, NCERT, Sri Aurobindo Marg, New Delhi-110016. Each article may not normally exceed ten typed pages.

The articles sent for publication should be exclusive to this journal.

Illustrations may be limited to the minimum considered necessary, and should be made with pen and indelible Indian ink. Photographs should be on glossy paper, at least of postcard size, and should be sent properly packed so as to avoid damage in transit.

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EDITORIAL

The warbling of the sun, solar flares or sun spot cycles have often been considered as phenomena of great scientific and technological interest to specialized physicists. But solar eclipses are very much more familiar and fascinating to common man and scientists alike. The mass response of the people to the obscuration of the sun by the moon has always been universal, varying of course, widely in manifestation according to regions, religions or customs. The solar eclipse like the one that occurred on the 16th February this year totally masking the sun by the moon, visible over a long narrow strip of peninsular India, generated unprecedented enthusiasm. An occasion like this gives a rare opportunity to analyse some important aspects of psychosocial beliefs and behaviour of man as a species besides providing immense scope for scientific studies.

Man has conquerred quite a bit of outer space and is on the verge of creating life. But in spite of all his success he has hardly been able to gain a comparable mastery over himself. The disparity and disability of men living in different societies at different stages of psychosocial evolution (say, an illiterate tribal as against the western) and between groups and individuals within the same society is imparing the progress of the species as a whole. Only a small minority contributes to the progress; a large section keeps going along with the mainstream of progress merely as receivers and appreciators while still others lag far behind being totally deprived of the products of modern ideas and devices. This aspect demands special attention of the science educationists since the whole thing is linked with education.

The root of all human progress is that man is the most educable and imaginative of all living creatures. He can learn and imagine things both sound and unsound, bad and good. The over all quality of his education is one of the most important factors determining individual and social differences within the species. The extent of human progress depends on the degree to which he can discriminate between the sound and the unsound, between verified facts and traditionally received prejudgements, prejudices or myths.

All individuals and societies including the most advanced ones, suffer from this limitation, varying in degrees according to the quality of education. This is not to emphasize that this dichotomy is a complete division between rational and irrational. It is evident that both factors are deeply ingrained in the system of beliefs held by every individual. It is also true that some of the so-called irrational beliefs or myths may have been arrived at through the same rational method and motif as the rational ones. For example, many of the so-called factually demonstrable beliefs of the advanced societies are in reality nothing more than superstitions. Superstitions are even derived from the secular religion of science. And we can hardly help it.

The store of the world knowledge is so vast and fast growing that it is not possible for any individual to confirm each of piece of knowledge for himself.

We simply have to accept on faith most of the truths to which we subscribe, on the basis of assurances of those who should know or on whom we rely. Sometimes we may be wrong in our choice. We are also prone to act on the basis of knowledge which have become outdated, based on subjective imagination or have subsequently proved to be wrong. This is how the myths and superstitions are made and perpetuated.

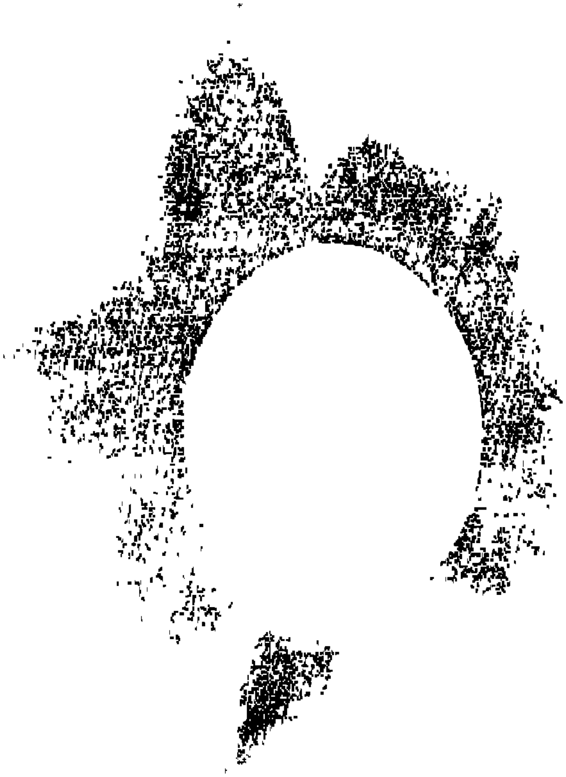
Coming back to the scene of this solar eclipse, we find strong reflection of the same basic theme and elements of human behaviour discussed above. The scientists of various grades and specializations tried to take the advantage of the temporary masking of the sun to uncover and understand many solar phenomena and their effects. The enquiries ranged from the observation of the corona to the behaviour of bacteria, bats and birds. Some scientists studied the stars and planets in the temporary 'darkness at noon'. Thousands of studies have been undertaken. The full impact of these observations are yet to be assessed. A few may be trivial or pseudo-scientific exercises while many more demanded extensive planning, deep cerebration, sophisticated gadgetary and hard labour.

To the lay man the eclipse has generated a feeling of fear as in the past and regarded as an event of darker forebodings than it would be supported by facts. In India alone crores of people of all religions held special prayers. Thousands of people organized special '*yajnas*' burning tons of ghee to ensure the relief of the sun god and ward off the misdeeds of Rahu and Ketu; lakhs of men and women took a special dip in the rivers and ponds after the eclipse to wash away the sins. More enlightened and so-called progressive sections of our society who often scoffs, at the tradition also suffered from mass panic of another kind. The cities and towns wore a deserted look as if under a rigorous curfew. The offices were closed. The most educated section of the population kept indoors away from the sun light. And strangely enough some scientists themselves aided by the mass media have contributed to the mass hysteria by vociferously announcing the possible adverse effects of the eclipsed sun on the eyes without any objective assessment of probability. Frequent warnings issued often, without proper explanation have only added to the misconception, that it is more dangerous to look towards an eclipsed sun than toward a fully blazing one hinting possible blindness and accidents.

This whole episode amply demonstrates another well known fact of human societies and individuals that they are divided into two kinds : those who attempt to seek the truths, devise things, explore nature, creates art and literature while the others solve the problems of real life by absconding from them. By far more people (even more valid in developed societies) are consumers of ideas and materials and not their makers. In the first category of people rationality is the dominant motif, and in the second myths prevail.

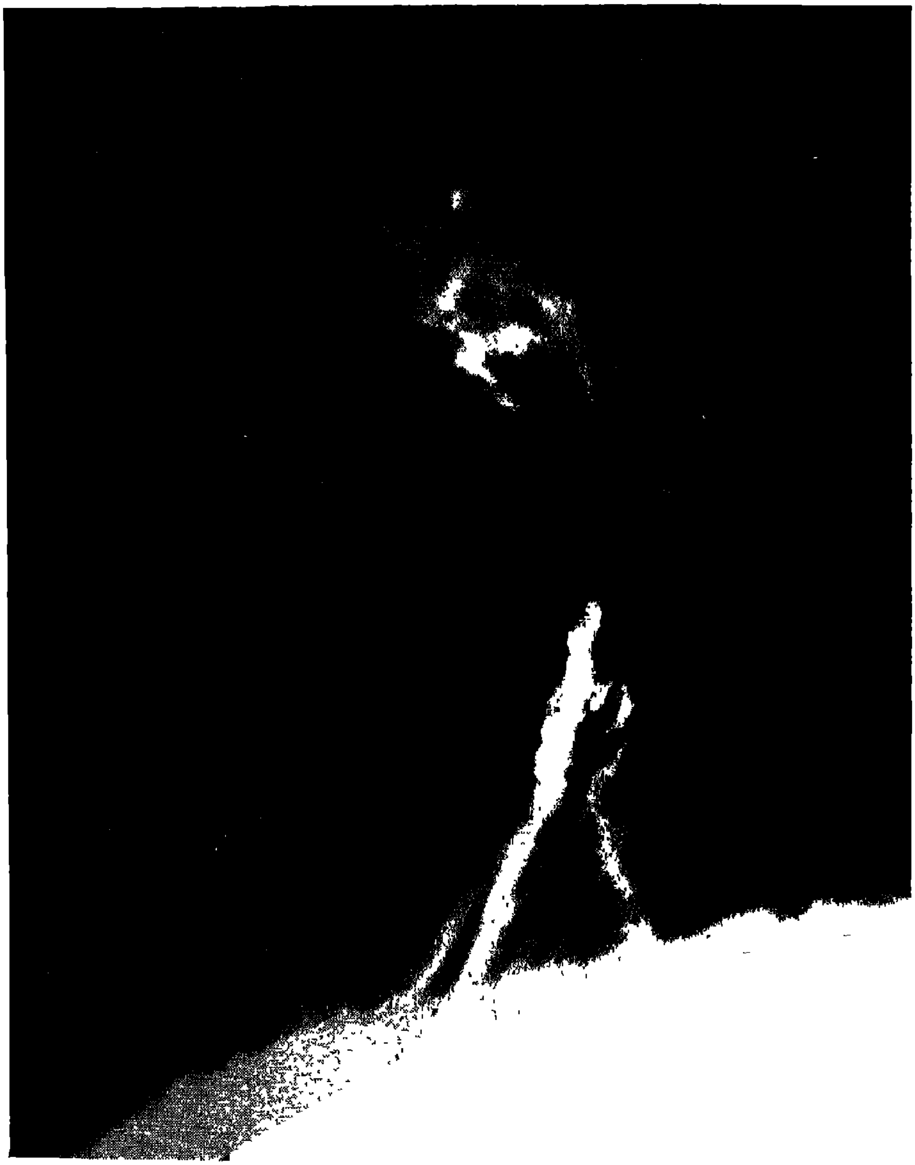
The difference between the above categories are not based on their capacity to be educated but mainly on the kind of education that is actually available to them. All of us are more or less educable enough to be able to distinguish between the probable and the improbable, the possible and the impossible. Science education and mass media in our country have a great role to play in this context to bring the whole society in tune with modern progressive ideas. ☐

Events of a total Solar eclipse



Solar Corona in detail : this photograph of a total eclipse shows more detail of the Solar Corona, one of the best ever taken

Events of a total Solar eclipse

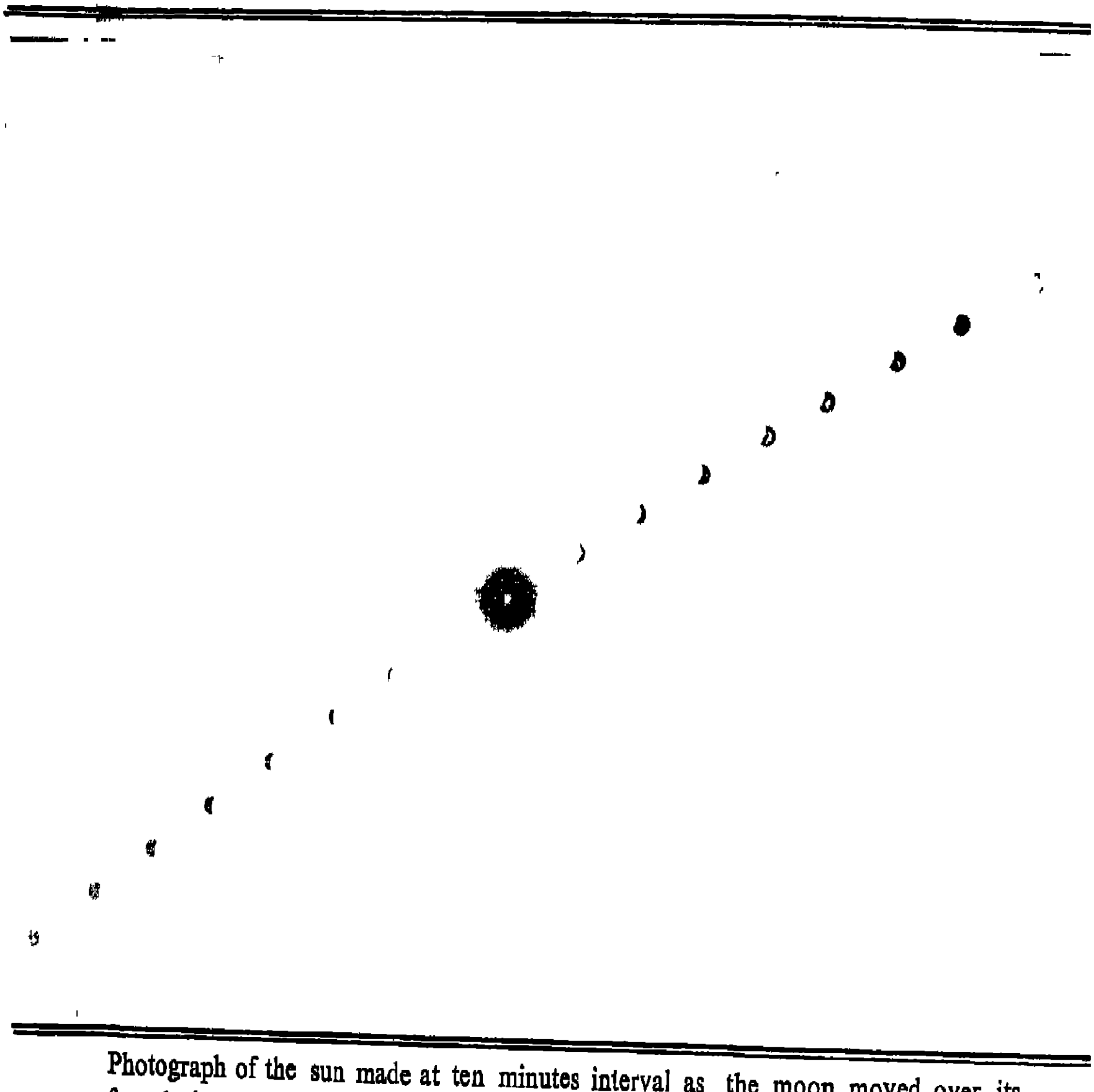


Burning hydrogen gas shoots from the surface of the sun in a column of flame about 1,00,000 miles high during a total solar eclipse. Many of these solar prominences happen daily, but cannot be seen expect during an eclipse because of the brightness of the sun

Events of a total Solar eclipse

Splash of light 'Baily's Bead' during the final stages of total solar eclipse

Events of a total Solar eclipse



Photograph of the sun made at ten minutes interval as the moon moved over its face during an eclipse. The stages duplicate on both sides of total eclipse. The flare of light from the middle image is the sun's corona.

Photographs : American Centre

Nobel Prizes in Science and Medicine

R. JOSHI
Department of Education in Science and
Mathematics
NCERT, New Delhi

THE NOBEL PRIZES for Physics, Chemistry and Medicine for 1979 have been shared by four Americans with a British, a German and a Pakistani scientist. The Nobel Prize for Physics has been awarded jointly to Abdus Salam of Pakistan and two Americans, Sheldon Glashow and Steven Weinberg. Herbert Brown of America will share the Nobel Prize for Chemistry with Georg Wittig of Germany. An American Physicist Allan Cormack, and a British research engineer, Godfrey Hounsfield, will share the prize for Medicine.

The Nobel Prizes were established by the Swedish Chemist Alfred B. Nobel who invented dynamite. Before his death in 1896 he bequeathed nine million ($ 9,000,000) dollars, the interest to be distributed yearly to those who had benefited the mankind during the preceding year. The first Nobel Prize was awarded in 1901. These awards are given for the outstanding contributions in the fields of physics, chemistry, medicine or physiology, peace and literature. The sixth award for economic sciences was introduced from 1969.

Awards for physics and chemistry are made by the Swedish Academy of Science, for medicine and physiology by the Stockholm Faculty of Medicine; for literature by the Swedish Academy of Literature and for peace by the committee of five persons elected by Norwegian Parliament.

The Nobel Prize is considered to be the highest honour conferred on an individual for his contributions.

A Giant Step towards Einstein's Dream

The Nobel Prize for Physics has been awarded to three physicists, Abdus Salam of Pakistan and two Americans, Sheldon Glashow and Steven Weinberg. These physicists, working independently, succeeded in providing the first step towards the solution of the puzzle which has eluded many great physicists for over five decades.

The puzzle relates to what is known as 'Unified Field Theory' put forward by the great scientist and philosopher of 20th Century, Albert Einstein. Einstein's general theory of relativity gives a geometrical interpretation of force. It succeeds satisfactorily in regard to gravitational forces. But Einstein was not contended by the success of his general theory of relativity. He was convinced that there could not be so much diversity in the forces that exist in the universe because nature calls for simplicity and coherence. He argued, therefore, that there must be an underlying unity between the fundamental forces. This is known as the "Unified Field Theory" which envisages that all the forces that hold the universe together are really the same or similar. The four fundamental forces known at present are gravitational force; which holds us to the earth; electromagnetic force which is responsible for magnetism, electricity, radio waves, etc.; plus two forces found in the nucleus of the atom—the so-called "strong interaction" that holds the nucleus together and the "weak interaction" that causes radioactive decay. The nature of the latter two forces was revealed after Einstein had presented his unified field theory.

Innumerable attempts have since been made to develop a single theory capable of interpreting the existence of all fundamental forces. Einstein himself tried to prove, for twenty years or more, that gravitational and electromagnetic interactions are same, but he never succeeded. Weyl, Eddington and Kaluzea are some other scientists who attempted to solve this problem but none could present a theory which had a complete success. The first person who ever suggested a link between 'electromagnetic interaction' and the 'weak interaction' was a former Nobel Prize winner, Julian Schwinger.

Sheldon Glashow and Steven Weinberg, two of the Nobel Prize winners for 1979 in physics, were the students of Schwinger at Cornell University. After their graduation, both of them started working on Schwinger's idea, but along different lines.

Meanwhile, Abdus Salam and John Ward were also working independently to develop a theory for unifying two of the fundamental forces i.e. electromagnetic and the weak interactions. The first successful attempt in unifying the two forces was made by them in 1961. But the theory faced with many problems, both theoretical and practical. The solution to one of the problems came in 1967 from Salam and Weinberg. The problem was related to reconciliation of the vast differences in scale between the two forces To accomplish this, they published their "Gauge Theory" to convert the two forces to a common scale.

However, Gauge Theory too could not solve all the differences observable in a radioactive decay. To do that, several scientists including Glashow postulated the "charmed" quark—a new, fourth type of nature's smallest building block. The existence of 'quarks' was, in fact, theoretically predicted by M. Gell-Mann, the 1976 Nobel Prize winner. According to him all observed particles are composites made up of certain fundamental particles i.e. quarks whose charges are multiples of ±1/3 e, where e is the charge on the electron.

Prof. Abdus Salam

In 1971, Veltman and T' Hooft of Netherlands resolved some other mathematical difficulties. The last problem to be solved was that of 'neutral currents'. A neutral current is defined as the current in which no change in charge takes place either before or after the reaction. On the other hand, in a charged current, such as we draw from a dry cell, the electrical charges do change.

The neutral currents had been observed in electromagnetic currents but not in weak interactions. Naturally the two forces would be same if neutral currents exist in both. The experiments, to detect neutral currents in the weak interaction, were set up in Fermi Laboratory in Chicago (USA) and the CERN Laboratory in Geneva.

In 1973, the neutral current was found to exist, just as Salam and Weinberg had predicted. The theory got a major boost after its reconfirmation at the Stanford Linear Accelerator at University of California in 1978. It convincingly showed that the weak nuclear interaction interferes with the electromagnetic force as predicted by the theory. An atomic physics group at Novosibirsk in Russia has also confirmed the Salam-Weinberg model.

The 1979 Nobel Prize for physics has, thus, gone to three men who have taken the first giant step to resolve the puzzle. Their unbounded perception has brought forward the first Chapter of the so-called "Unified Field Theory" showing that electromagnetic forces and weak interaction are essentially the same, only their menifestations at the levels we see them are different.

The mathematical contours of Prof. Salam's theory are such that it should be able to unite the third force—the strong interaction. However, the fourth entity i.e. gravitation seems to be hardest nut to crack. But there is no doubt that scientists will solve these problems in near future. Once this is achieved, it will bring a conceptual change in the whole scheme of universe in which we believe at present.

Abdus Salam

Prof. Abdus Salam was born in 1926 in Jhung, a small town in the heart of rural Punjab (Pakistan). His early education took place in this small town where he did his matriculation and intermediate in arts. On both occasions he topped the list of successful candidates. Thereafter he went to Lahore and took his Bachelor of Arts degree from Punjab University, securing first position. In 1946, he passed M.A. in mathematics again securing highest marks in the University. Then came what he calls the first break in his career. It was in the form of a scholarship for higher studies awarded from the Farmer's Welfare Fund instituted by the then Punjab Chief Minister. He went to England to study at the Cambridge University the same year.

At Cambridge he took honours in mathematics and also took the physics tripos and thus completed three years work in just one year to claim a double first in physics and mathematics in 1948. After spending one year on research at Cambridge he went to Institute of Advance Studies at Princeton, United States on a fellowship where he worked for sometime with Professor Oppenheimer.

The following year, Salam returned to Pakistan, where he was first appointed at Govt. College, Lahore and later shifted to Punjab University as Professor of Mathematics. Besides teaching mathematics at Govt. College, Lahore, he was also made incharge of the college football team. He returned to Cambridge in 1954 as lecturer in mathematics where he remained until 1956.

He left Cambridge to join Imperial College of Science and Technology, London, as Professor, the post which is still held by him. He is also Director of International Centre for Theoretical Physics at Trieste, Itlay, and serves as Chairman of the UN Advisory Committee.

A large number of awards and honours have been bestowed upon Prof. Salam in recognition of his work. Hopkin Prize and Adams Prize of University of Cambridge; the 'Pride of Performance' medal and 'Star of Pakistan medal awarded by the President of Pakistan (1959); Hughes medal of Royal Society and British Physical Society medal are some of the long list of awards and honours to his credit. He was also elected Fellow of Royal Society, the first Pakistani to be so honoured.

He is the creator of the modern theory of 'Neutrino', an elementary particle. His theory of 'Parity' has been recognised by all scientists. Prof. Salam's major work in the 60's was on symmetries of particles—one aspect of which was the discovery of 'Omega Miuns' particle.

A true disciple of Islam, Prof. Salam has proposed to give his share of Nobel Prize in Philanthropy in Pakistan for helping young scientists.

Sheldon Glashow and Steven Weinberg

There is a remarkable similarity in the careers of two American physicists who will share Nobel Prize with Prof. Abdus Salam. Both of them were born in New York city and were 46 years old at the time of announcement of Nobel Prize They were classmates at the famous Bronx High School of Science, New York. The Bronx High School is known all over the world for catering to exceptionally bright students and perhaps has the distinction of producing highest number of Nobel laurates. After their schooling both entered Cornell University and did their graduation together. Sheldon Glashow and Steven Weinberg were Schwinger's students at Cornell University. It is but natural that they started working on the then revolutionary proposition of Schwinger that electromagnetic and the 'weak interaction' are same. In fact, Glashow devoted his thesis to this revolutionary idea.

After that there is a slight variation in their careers. Though both worked on the same problem but along separate lines. At present, Prof. Glashow is working at Massachusetts Institute of Technology whereas Prof. Weinberg is associated with Harvard University.

Synthesis of Wonder Compounds

The Nobel Prize in chemistry has been shared by Herbert Brown (67) of America with George Wittig (82) of Germany. Both of them, working independently, have successfully used different chemical links to join larger molecules into the combinations that were considered impossible or difficult earlier. Thus, their researches have provided a breakthrough in large scale manufacture of new wonder compounds. These compounds have wide variety of uses from pesticides to drugs to atomic energy.

Sheldon Glashow (left) and Staven Weinberg (right)

Herbert Brown

Herbert Brown was born in London and his family moved to Chicago in United States when he was two year old. According to him he grew up in a very poor family settled in a very rough section of the society.

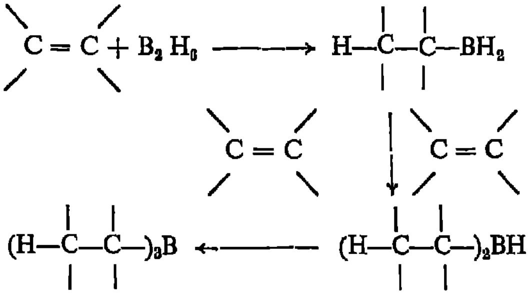
The Nobel Prize to Brown has been awarded in recognition of his work relating to compounds of the elements boron and hydrogen. He has worked for about 40 years on these compounds which are called 'boranes'. Boranes have a special ability to forge temporary links that makes it possible to join larger molecules into combinations that were considered difficult or impossible. Besides, Prof. Brown is also renowned for his theoretical contributions to carbo-chemistry.

Brown first started his experiments with boranes when he was a graduate student at the University of Chicago in 1930s. He remembers that at that time these compounds were very rare and were available only in small quantities. As a result of discoveries made by him and large number of other chemists today boranes are used in enormous quantities by thousands of chemists working in industries, fertilizer plants, drug plants, atomic plants, laboratories and many other places.

The feature of boranes which makes them of such interest is the fact that there are not sufficient number of valence electrons in the molecules to bind together the atoms by electron pair bonds if reasonable structural formulae are presumed. For example, the compound diborane ($H_3B.BH_3$) has seven bonds and only 12 valence electrons. Though boron has the ground state $1s^2\,2p_x^2\,2p^1$ but its neutral compounds are always trivalent and not univalent. Boron utilizes three outer shell electrons to form three coplaner Sp^2 bonds in the compounds of the type BY_3.

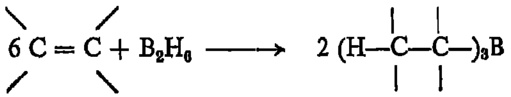
Dr. Herbert Brown

How boranes help in synthesis of compounds may perhaps be understood by studying the reaction known as hydroboration. This is one of the reactions discovered and developed by Herbert Brown. In hydroboration, boranes (e.g. diborane) add smoothly to alkenes to give trialkyl boron compounds. The addition proceeds in a stepwise fashion via successive addition of each boron hydrogen bond to alkenes.



(A trialkylborane)

The stoichiometry of the over all reaction is therefore



$$6\,C=C + B_2H_6 \longrightarrow 2\,(H-C-C-)_3B$$

This reaction has tremendous synthetic utility because the trialkyl boron compounds undergo many useful transformations.

The work of Brown have also led to a uranium compound that was used to refine fuel for nuclear reactions during World War II. Prof. Brown's researches on boranes has made possible the manufacture of more than 50 versatile borane compounds and hydrocortisones, steroids and prostaglanding—drugs prescribed for a number of ailments including arthiritis. He holds patents of numerous chemicals.

A whole new class of pesticides used now-a-days is due to his discoveries. For example, to a male insect, a compound developed by

Georg Wittig

Brown seems to resemble the sex attractant of a female. When such a compound is sprayed in a limited area or a trap, it confuses the male insects who fly aimlessly and futilely in search of a female to mate with or to be trapped. This greatly reduces the second generation of insects.

According to Brown there are many intersting possibilities. He says "I feel that we have uncovered a new continent, just beginning to explore its mountain ranges and valleys. But it will take another generation of chemists to fully explore and apply this new chemistry".

Georg Wittig

Georg Wittig, 82, like Brown, has successfully used the chemical links to make a breakthrough in the synthesis of new wonder compounds. He has accomplished similar results, to those of Brown, with chains of phosphorous, hydrogen and carbon instead of boranes.

Georg Wittig was born in Berlin in 1897 and grew up in Kassel. Having an international reputation, Wittig is considered to be among the last chemists in West Germany who have a command on the whole field of chemistry. He has done intensive research on organometallic compounds. The organometallic compounds are considered to be hybrids between inorganic and organic compounds. The synthesis of these compounds have been made possible by a reaction developed by Georg Wittig in 1954. This reaction is now known as Wittig reaction. In this reaction a carbonil compound reacts with an organic phosphorous compound to yield an organometallic compound. The structure of carbonil compounds, such as ketones and aldehydes, is such that they contain a double bonded carbon and oxygen group C=O whereas organic phosphorous compounds e.g. alkylidene-triphenyl-phosphoboranes have the formulae $(C_6 H_5)_3$ P=CR_2 in which R stands for a hydrogen atom or an organic group. In Wittig reaction, the oxygen atom of carbonil group is replaced by alkylidene group CR_2 of the organic phophorous compound to form an olefin which is a hydrocarbon containing double bond. The reaction enables to synthesize a wide variety of new compounds just by changing one of the reactants, i.e. organic phosphorous compound. This can be done by simply taking the compounds with different groups represented by R. The Wittig reaction has been successfully applied in the synthesis of cholesterol precursor, squalene; of lycopene, the red pigment of tomato and vitamin D_3.

Through his work Wittig has also contributed in bringing together organic and inorganic chemistry. The organometallic compounds developed by Wittig have proved to be most interesting tools in chemistry. They have provided chemical industry with the means of carrying out elegant and economically interesting syntheses.

The 'CAT' System

The 1979 Noble prize for medicine has been awarded jointly to a British research engineer Godfrey Hounsfield and a US physicist, Allan Cormack. The prize has been awarded for developing computer-assisted tomography, an X-ray technique which gives a strickingly clear view of living human body. The basic research on the 'CAT' system, as it is known, was done independently by Hounsfield and Cormack.

Allan Macleod Cormack

In simple words computer-assisted tomography involves a series of X-rays of successive sections of the body from all angles. The assistance of computer is sought not only for scanning the body but also to build a highly detailed image for examination. The scanning X-ray gives an almost three dimensional view of the smallest parts of the human body. It can even give an isolated view of thin slices of brain or body so that any abnormality can be detected immediately.

The CAT system is being used successfully in the hospital for over six years. It has greatly strengthened medical diagnostic methods particularly in the examination of brain and nervous system. It has been found to be a quicker, safer and surer teachnique for diagnosis of brain damage and detection of tumour and other irregularities.

Allan Cormack

Prof. Cormack, 55, was born in South Africa and educated at the University of Cape Town. He moved to United States in 1956 and became a US citizen 10 years later. Presently he is working as the Head of the Physics Department of Tufts University in Medford, Massachusetts. He was first to analyse theoretically the possibilities of developing a radiological cross section of a biological system. The concept of the scanner was published by him in 1963 and 1964. However, it did not receive much attention at that time. It was only in 1970 that a British firm started manufacturing a scanner based on similar concepts.

Godfrey Hounsfield

Dr. Godfrey Hounsfield, 60, is a research engineer with British company EMI, which is known best as a producer of record albums but also makes medical and other electronic equipment. He has also done pioneering work in the development of large solid state computers.

Hounsfield, working independently, developed a working model of X-ray scanner between 1969 and 1972. In order to make this technique usable for the diagnosis of disease in brain he successfully tackled a number of obstacles. Besides Nobel prize, he has received several honours for his invention of the scanning X-ray or 'Computerized transverse axial tomography system for X-ray examination' as it is more technically known.

Presently Dr. Hounsfield is engaged in developing the model of a still more sophisticated scanner. ☐

Dr. G. Hounsfield

The Study of Solar Eclipses

RAVI P. BHATIA
Department of Education in Science and Mathematics
NCERT, New Delhi

A TOTAL SOLAR eclipse, a great natural spectacle was visible from India on 16 February, 1980. This was a very rare event because the last total solar eclipse that people in India saw was on 22 January, 1898—fully 82 years ago.

The eclipse first appeared at 7 12 a.m. (G.M.T.) in a narrow belt in the Atlantic Ocean about 10,000 km west of India. The region of its visibility passed through Africa and cutting across the equator, it travelled in a north easterly direction till the west coast of India.

This narrow belt of totality of the solar eclipse was about 120 km wide starting from just south of Panaji in Goa (15° latitude) and spreading north eastwards passed through the states of Karnataka and Andhra Pradesh and ended in Orissa.

The times of visibility of the eclipse varied from place to place. On the western coast of India it was visible at about 10.10 a.m. (G.M.T.) or 3.40 p.m. (I.S.T.) At Puri in Orissa, the time of visibility was about 3.55 p.m. The total time from west to east coast was only about 16 minutes. The duration of the totality of the eclipse at any one place also varied but on an average was about two and a half minutes. It was maximum on the central line of the belt.

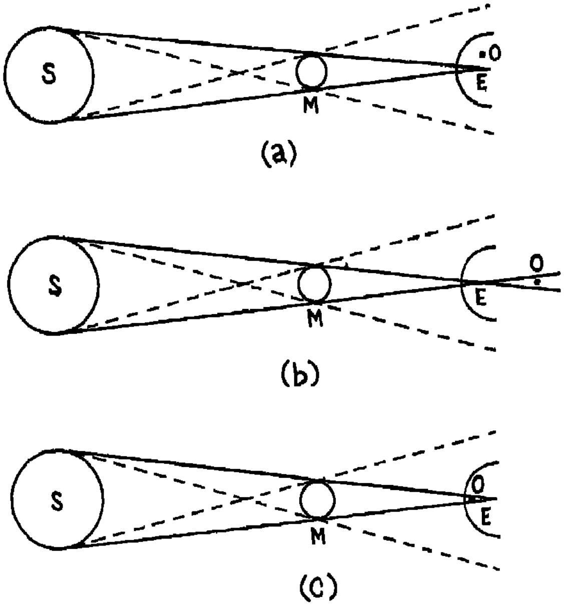


Fig. 1

Although the total solar eclipse was visible only during this time and from this narrow belt, a partial eclipse was observed from large regions on the earth. This can be understood by referring to any elementary book[1]. A solar eclipse takes place when the sun, the moon and the earth are in line, with the moon in between them. This happens on newmoon day (*amavasya*). The moon casts a shadow on the earth by blocking the sun's rays from the earth. Depending upon how much of the sun is blocked by the moon and where the observer on the earth is stationed, the eclipse is partial, annular or total.

To understand the difference between these types of eclipses and how they are caused, consider the diagram given above (which is not drawn to scale).

Let S, M and E represent the sun, the moon and the earth respectively. Let O be an observer stationed at some place on the earth which is facing the sun. In the diagram, the region of the moon's umbra is represented by full lines and the penumbra is represented by dotted lines.

If O lies in the penumbral region as shown in the sketch (a) he will observe only a partial eclipse because the sun will be only partially blocked by the moon.

In the sketch (b) however, O lies in the umbral region and to him the sun will be totally eclipsed. In the sketch (c), O lies beyond the umbral region and he will see all of the sun blocked excepting for a narrow ring at the periphery. This type of eclipse is called annular eclipse and is shown in Fig. 2.

Whether the eclipse is partial or total, depends not only on the position of the observer O, but also on the relative positions of the moon and the earth with respect to the sun. We have seen that the solar eclipse takes place on *amavasya,* but not all *amavasyas* produce a solar eclipse. This is so because the moon does not move around the earth in the same plane as the plane of the earth around the sun. The latter plane is called the *ecliptic.* The moon's plane oscillates about the ecliptic through a small angle of 5 degrees. Consequently, the conditions necessary for a solar eclipse are (a) the moon is new, and (b) that it lies on or very near the *ecliptic.*

It is for this reason that the solar eclipses are relatively rare. On an average there are about twenty four eclipses in ten years^2. The maximum and minimum number of eclipses possible per year are five and two respectively. On an average there are eight annular and seven total eclipses per decade somewhere on the earth.

As we have seen, the total eclipse lasts for about two and a half minutes. During this time it becomes sufficiently dark for some bright stars to become visible. This fact was made use of in verifying Einstein's prediction of bending of light when it passed close to the sun or any other heavy object. In 1917, Einstein had shown in his paper on general theory of relativity that just as the sun attracts material objects because of the gravitational force, it will deflect light also due to the same force. He had made an exact calculation for the amount of bending of light when it passed close to the sun.

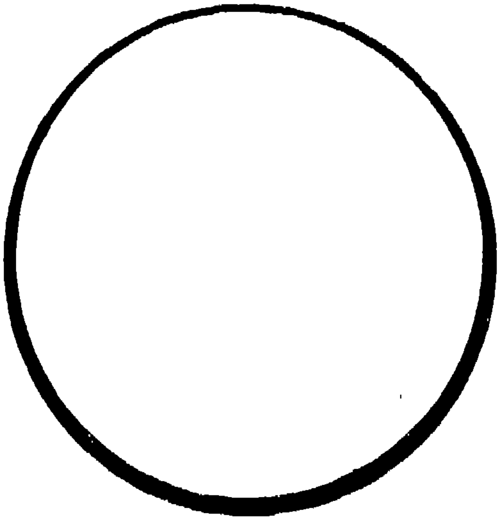


Fig. 2

On comparing the photograph of the stars during the time of the solar eclipse of 1919 with the photograph of the same stars at night time, it was found by a British team of astronomers led by Arthur Eddington that Einstein's prediction was indeed correct.

During the time of the solar eclipse, the *corona* of the sun also becomes visible. The *corona* is the outer atmosphere (the inner atmosphere being called *chromosphere*) of the sun and consists of gases which are at lower density than that of the sun. The *corona* also emits light, but in normal conditions it is not visible because the light emitted by the sun is so much brighter than it. Its intensity is approximately equal to that emitted by a full moon. Since the *corona* is normally visible only during the eclipse, many experiments are carried out to study the nature of its spectrum and polarization.

The light emitted by the sun consists of different wavelengths including infrared radiation (wavelengths larger than $6x10^{-4}$cm) when one looks at the sun during its normal brightness, its light is so bright that it dazzles the eyes and the person looks away. But during the eclipse, the light is blocked by the moon and one would not be dazzled by it. However, even during the eclipse the infrared radiation reaches the earth, and it is this light which is very harmful to the retina of the eyes. It can in some extreme cases even cause blindness. It is for this reason that one should not look at the eclipse directly. However, during totality, it is safe to look at the eclipse directly because the intensity of light reaching the earth is very small. Apart from its research aspects, the total solar eclipse is an aesthetically beautiful experience. Just about half-an-hour before totality, there is no apparent effect but then the light gradually begins to fade as an increasing portion of the sun is blocked by the moon. About a minute before the totality, one can see the moon's shadow approaching from the westerly direction.

Then a strange event takes place. As the moon has almost completely blocked the sun from view, the sun's rays reach the earth through the valleys and depressions of the moon in the shape of what is called *shadow bands*. Just when the sun is totally eclipsed another striking phenomenon can be observed. The chromosphere starts flashing out in all its dazzling brightness, heralding the start of the total eclipse.

During the eclipse, with the light intensity gradually fading, birds, animals and even flowers may behave as if night is approaching on them. Birds may start to return to their nests and the nocturnal animals like owls and bats come out. Human beings have also been noticed to behave in an odd manner during the eclipse, for religious or other reasons.

Altogether, the phenomenon of the total eclipse is something that people with a feeling of beauty and adventure will enjoy. They will cherish this event for the rest of their lives and for this reason anyone who can, should not miss this once in a life time experience.

A team of scientists (including the author) and photographers from the Department of Teaching Aids, NCERT went to Andhra Pradesh to observe and photograph the total solar eclipse. We viewed the eclipse from a place called Amrabad (about 130 km from Hyderabad) where there is a pond and a small sanctuary with some birds and bats. During the time of eclipse we failed to see any unusual behaviour in either birds or bats.

But the eclipse itself was indeed a wonderful experience. The only thing that marred the beautiful sight was that some clouds partially blocked the sun For this reason, we could not see the planet Mercury which become visible during the totality. We could however see the planet Venus. No stars were visible because it did not become completely dark. On the whole it was a sight worth watching. ☐

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[1] Learning Science through Environment, (Class V), NCERT, 1979.

[2] For details consult *Principles of Astronomy by* Stanley Wyatt, or some similar book.

Aspirin—A Wonder Drug

A.N. Bose
Department of Education in Science and Mathematics
NCERT, New Delhi

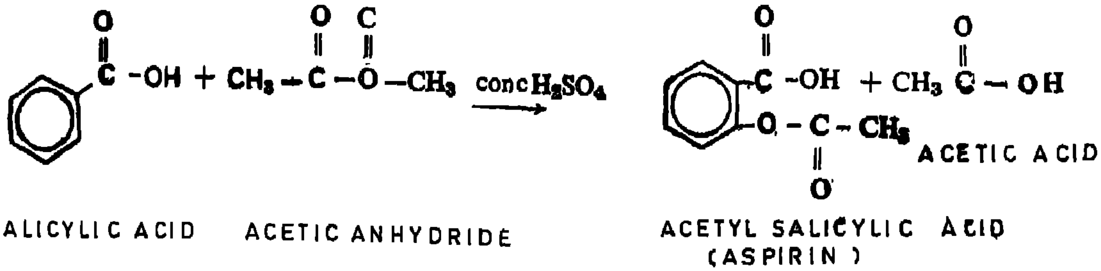
Bodily Pain, from mild or moderate headaches to severe sufferings related to various kinds of injuries and diseases, has been a very common source of misery with man and other animals. In some cases, the pain becomes so acute that its relief rather than removal of its cause becomes apparently the most immediate concern of the doctor. People have been taking recourse to various measures, application and administration of all conceivable substances ranging from simple rubbing with water or clay to application of varied preparations of inorganic, plant and animal materials. All schools of ancient healers and modern medical profession have been actively looking for really effective, but otherwise harmless, pain relieving devices and drugs.

Barks of many trees were used for relieving pain, treatment of gout, etc. even before 2000 years. The barks of these trees contain salicylic acid and chemical substances derived from it. About 200 years ago, Edward Stone in England used bark of the Willow tree for treating body-ache and pains caused by atmospheric humidity. The bark of the Willow tree contains salicylic acid as one of the ingredients.

Kolbe was the first person to synthesise salicylic acid, sodium salicylic and phenyl salicylate in the laboratory in 1859. All these chemicals were used as medicines. Due to their low solubility in the acid produced by the stomach wall these substances remain in the stomach for a considerably long period and cause irritation in the gastric area. Hoffman prepared acetyl salicylic acid, a derivative of salicylic acid. This compound is more soluble in stomach-acid, causes less irritation. It proved to be a better medicine than other compounds of this group. In 1899, Bayer Company of Germany patented acetyl salicylic acid as 'aspirin'.

Acetyl salicylic acid is prepared in the laboratory by treating salicylic acid with acetic anhydride in presence of concentrated sulphuric acid. The reaction is exothermic. When the reaction mixture cools, acetyl salicylic acid separates out as crystals. In order to get the pure compound, it is recrystallised by dissoleving it in benzene.

Aspirin has many important properties as medicine—It (a) kills pain (analgesic); (b)



reduces swelling (anti-inflammatory); (c) reduces fever (anti-pyretic); (d) gives relief to symptoms of arthritis and gout (uricosuric); and (e) prevents heart attacks (blood clots). Let us examine how aspirin is effective in all these cases

There can be mainly three sources of pain: (i) Pain from skin or from tissues just below the skin, (ii) Pain from internal organs; and (iii) Muscular pain. There are two types of analgesics. Analgesics like morphine act on the central nervous system and kill the pain whereas drugs like aspirin act mainly in the peripheral or outer parts of the body. One of the major causes of the peripheral pain is abnormal accumulation of hormones known as prostaglandins in the tissues in the region of the pain. This class of hormones are present in the tissues. But whenever some cells or tissues are damaged in a particular region, further synthesis of prostaglandin molecules takes place. Even brisk rubbing of tender skin areas cause pain due to synthesis of prostaglandin. If the concentration of prostaglandines increases above the normal amount, pain starts by activating the nerves which cause pain. Excess of prostaglandins also causes the induction of redness, swelling and fever. Prostaglandins produce headache when injected into the blood and cause fever when injected into the brain. Aspirin inhibits the synthesis of prostaglandines and thus gives relief to pain. In 1976, another hormone, called prostacyclin, has been identified. This hormone is thirty times more effective than prostaglandins It is just possible that it also has the similar effect as prostaglandin in causing pain, fever, etc. But this fact is yet to be established by further researches.

Hypothalmus region of the brain controls the body temperature. One of the reasons for the fever caused by infection due to certain bacteria is that when such bacteria reach the hypothalmus region of the brain, they initiate synthesis of prostaglandines excess of which in this region of the brain causes fever. Aspirin is effective in reducing the body temperature because it inhibits the formation of prostaglandin.

Prostaglandines have another property of clotting the blood Sometimes, there are blood clots in the arteries which supply blood to brain. When these clots reach thinner blood vessels near the brain region, they block the passage of blood reaching the brain. As you know, blood contains haemoglobin which carries oxygen to brain. When the passage of blood is blocked by clots, there is insufficient supply of oxygen in the brain. This results in a stroke. Since aspirin retards the formation of prostaglandines, therefore, it is effective in preventing strokes. Latest studies have shown that low doses of aspirin can stop clots in the blood vessel and thus reduce the danger from strokes.

It has been pointed out earlier that aspirin is a better medicine than most of the compounds of this group, but still it has some adverse effects. It irritates the lining of the stomach and causes a small amount of blood loss. Two tablets of aspirin cause approximately 20 drops of blood less from the stomach.

World consumption of aspirin is 1,00,000 tonnes each year. Persons suffering from pepticular vitamin-K deficiency or haemophilia are advised not to take aspirin. In these cases, whenever there is a haemorrhage, the person bleeds to death because aspirin reduces the ability to form clots which stops bleeding. High doses of aspirin may cause bleeding in the gastrointestinal region. Some persons are allergic to aspirin. In such cases, it causes breathing trouble or skin rashes. They should avoid taking aspirin.

Thus, we find that such a simple organic molecule is so effective for many human sufferings. Some day, we might find a simple substance for the effective treatment of diseases like cancer, etc □

Mushrooms as Food

M.P. SINHA
Regional College of Education
Bhubaneswar

MUSHROOMS ARE a group of non-flowering plants, devoid of chlorophyll, known as fungi. Musrooms with their well known caps and stems are the fruiting bodies, noticed by all. It contains small microscopic spores formed for reproduction. The vegetative non-productive thread like parts (spawn) always remain inside the soil or wood or humus. During summer and dry season it remains dormant but during rainy season or when it gets water becomes active and produces the fruiting bodies with the cap and the stem. These fruiting bodies are actually used as food, in some part of India as necessity and in western countries (Denmark, America, West Germany, Switzerland) as delicacy, taste and food value Japan is equally ahead in the mushroom industry.

In India at Solan considerable quantity of a particular type of mushroom; *Agaricus bisporus* is produced, processed and exported. In some of the leading research centres like IARI, New Delhi and CFTRI, Mysore and at Coimbatore different kinds of mushrooms are being experimented for the table purposes and food value. As far as its food value is concerned, it is as good as any fresh vegetable. But some times its value has been over emphasised to tell that it can replace meat, which is not true. From 80 to 90 per cent of the substance consists of water, and there are small proportions of nitrogenous substances (not all digestible), carbohydrates, fats, mineral matters, vitamins and proteins. In fact Dr. Williams of Texas University reports that folic acid was present in far larger quantities in the mushrooms than in any of the other materials containing folic acid. Glucose and fructose have been found to be relatively high in *Agaricus compestris*. According to some workers it is believed glycogen is hydrolysed to glucose and then converted into fructose and manitol in living mushrooms. The protein content of certain edible fungi have been reported to vary from 8.87 per cent to 32.96 per cent on dry weight basis. The commonly cultivated *Agaricus compestris* was found to contain 0.12 gram of Thiamine, 0.52 gram of Riboiflavin, 8 60 of hacarbic acid, 5.85 of micotenic acid and 2 38 grams of panthevic acid in every 100 grams. In fact, in many of the American hospitals it is the part of the diet of anaemic patients and is prescribed for the protein deficiency of vegetarians.

The importance of mushroom is not only in its food value but in its taste, flavour and foreign exchange earning capacity. If the processing is good and preparation is careful then it can compete most of the vegetables, but that depends upon a number of factors and experiences. Among many other things the first and foremost thing of precaution is to distinguish between the poisonous and the edible varieties. Though from time immemorial people have used mushrooms as food, gone under the various accidents of poisoning, but till today there is no scientific method of certainity to distinguish between the poisonous and the edible ones. Many people talk many methods to detect the poisonous one by putting spoon in the cooking vessel, smell, pressing with thumb but none of these have any scientific value, even turning the container little black many mushrooms are edible, carefully examining, almost every variety has got some smell. Some of the very common

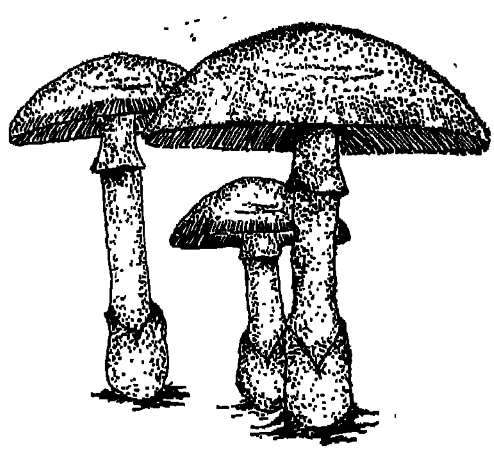


Fig. 1 Amanita (poisonous) species

edible mushrooms may turn black brown due to thumb pressing. Therefore, ultimately it is the experience, except in one case where distinction can be made between the poisonous and the edible mushroom. This is the presence of both volva; a round covering at the base of the stem and a thin ring round the neck (Fig. 1). If both those structures are present in the specimen it should not be used because it belongs to the group *Amanita* which is in most of the cases are poisonous. Some of its species are having hallucinogenic compounds, and due to that it is doubted that the 'somarasa' of Himalayan plant was extracted from this. Fortunately this species is not very common, and others like some species of lepiota are not fatal, but cause digestive troubles. Apart from this any mushroom with bright shining colour should not be used. Some times, mushroom become unusable due to delayed collection. As far as possible it should be used fresh, fried, dried or processed. Mushroom is attacked by many insects within a few hours of its sprout, and some times the insect in gills of the cap or in the stem are cooked and create digestive or other types of disorders. So preparation should be of every fresh and clean specimens.

The preparation for table depends upon the nature of food habit. Generally in India it is used as a part of other vegetables, but in that common method it loses its taste and flavour. Because mushrooms should not be washed unless it is necessary in which case they should be rinsed quickly and dried. Some mushrooms are good if cut into pieces and coated with egg and fried in ordinary oil. There are many other methods of preservation and cooking according to convenience, habit and availability. The method of cultivation is also very simple.

Fig. 2 Volvariella (edible) showing the only sheath at the base

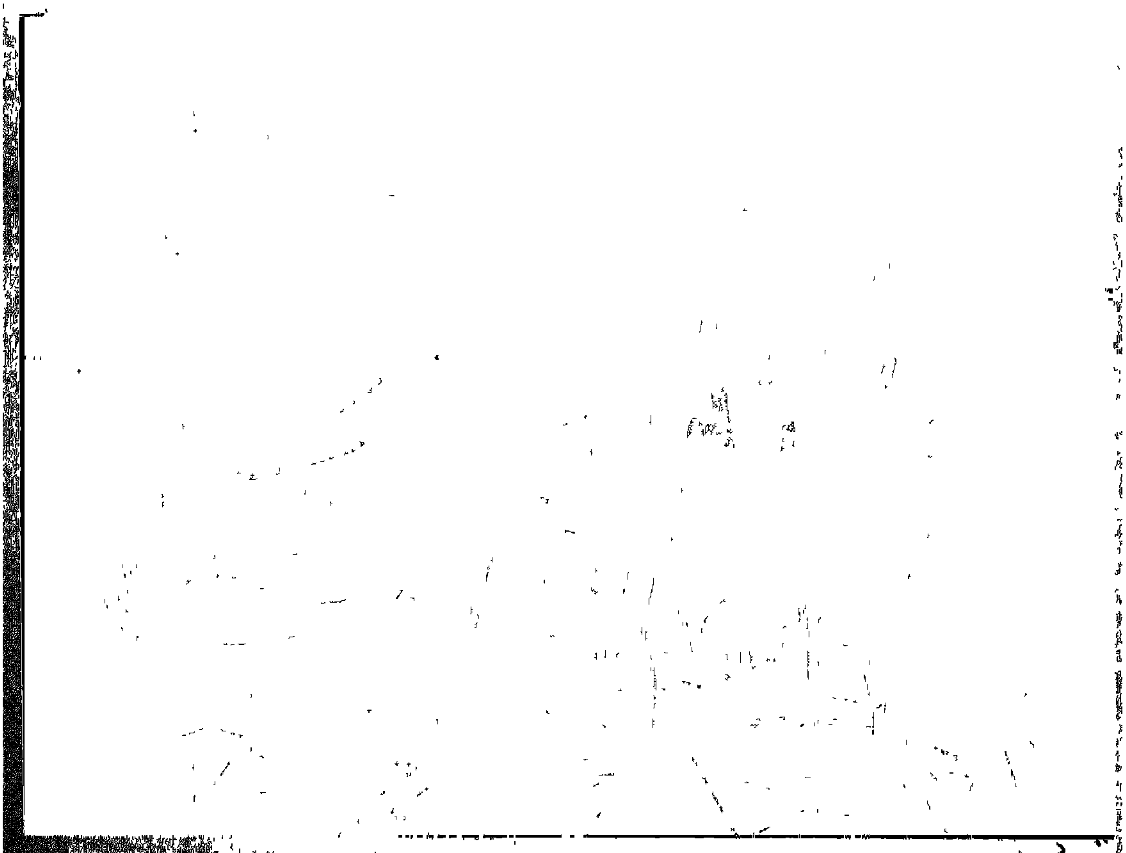


Fig. 3 Volvariella in full bloom at R.C.E., Bhubaneswar

Though, Prof. S.R. Bose had proposed a mushroom industry for the eastern India in the early fifties, yet none of the states took it seriously. It was only in the year 1978 when the Department of Agriculture, Government of Orissa started spawn (so-called seed) producing centre at Bhubaneswar, and spawn is being sold on commercial basis. This experience shows that in the coming years the fresh or processed and tinned mushroom will reach Calcutta market. The Department of Botany, RCE, Bhubaneswar is producing *Volvariella* (Figs. 2 and 3) which is greater in size, better in taste, soothing in flavour and look, and equally good in food value.

FURTHER READINGS

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Science Education for a Changing World

Banku B. Ganguly
Department of Education in Science and Mathematics
NCERT, New Delhi

The target of the International Year of the Child is to strengthen the efforts towards the improvement and preparation of the children who are the citizens of the future. The Science Education also has the similar aim. The last 20 years have witnessed the coming of the changes in the trend of science education and all these new trends are directed to prepare the children to live constructively and cooperatively in the world of 21st century. Like all other countries of the world, India is also attempting to strengthen its science education. The present article attempts to discuss how in India science education can be effective to fulfil the aims and objectives for improving the child which are also desired in the programmes of the International Year of the Child.

Nature of the Changes

THE WORLD IS changing. The changes are due to the developments of science and technology. The changes were slow in the beginning but in the 20th century it has happened at a break-neck speed. In the last eighty years, science and technology has made tremendous contrubution towards the solution of basic problems—food, diseases and shelter. Developments have also taken place in the areas of travel, communication, energy sources and information storage. All these developments have changed the physical and social environment and have brought a new order in the economics, politics and social life. In future these changes are going to be at a faster rate. Thus, intrusion of these developments in the name of 'modernization' is going to distort the prevaling social pattern. More confrontations between old and new order are going to arise.

The main feature of these changes is the coming of a 'modernization', with better kind of life and better kind of things but at the same time forcing the people to live in a crowded world confronting war, hunger, pollution, poverty, exploitation, sinking of resources and racial problems. In addition, these changes are creating a new kind of division within the society. Some people are enjoying more resources than others. Those who do not enjoy the fruits of science and technology consider themselves unfortunate and helpless. The coming of modernization does not mean anything to them and it only increases their inferiority complex. And as Black (1978)* has pointed out—"Modern education teaches the child that he is ignorant. Modern medicine that he is sick. Modern dress employ that he is dirty and shabby. Modern consumer goods show that he is poor. The old ways are to learn only in order to be discarded". The group enjoying the fruits of modernization considers the rest who are deprived, as destitutes with no experience and treat them as burden to the society. Unless we are careful, this gap is bound to widen.

In order to minimise the confrontation between old and new order and to reduce the gap between "haves" and "have nots", it is not possible to stop the developments in science and technology. A number of unsolved problems are demanding solutions from science and technology. For example, inspite of tremendous development, the problems of food, diseases and shelter are still persistent. Several new problems like over population, pollution, nuclear hazards, energy shortage have cropped up due to misuse of the benefits of science and technology. It is not possible to live with these problems, therefore application of science and technology will continue. This means that modernization will advance, bringing more changes. The only possibility remaining is to prepare for facing these changes. As children for today are going to be the citizens of future changing world, such preparation is essential for them.

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*M. Black (1978). Coming of age: The Rural Child in Kenya; Unicef News, 97, 78, 3, p. 10

Preparation for Living in the Changed World

It was thought earlier that information about the facts of science and technological know-how are the most required preparations for the future. Such thinking was based on this feeling that human beings can master the nature with the help of science and technology. Economic development was thought to be linked only with scientific and technoligical development. Only in recent years there has been serious revision in this thinking. Inspite of tremendous scientific development, mankind is facing the threat of extinction and economic superiority does not stand any guarantee to this threat. Never before the need for living together was felt so urgently because, it has been realised that fight against the problems demand cooperative and collective actions. The abandoned Gandhian concepts like "rural development" and "small is beautiful" have been revitalized and efforts are in progress to improve the status of human beings. With these ideas in the coming, preparation of the future citizens have been envisaged for the following.

A. *To Take Part in the Scientific and Technological Advancements*

The history of science and technology is as old as the history of human beings. As all human beings do work, some form of technology is found everywhere for helping in the work. Some countries use advanced technology whereas in some the technology is not sophisticated. New techniques and know-how are coming fast in the developing countries and though slowly yet continuously these new developments are diffusing in the community. We need trained people to take part in this growth of science and technology and in its maintenance. All technological developments in agriculture, health, industry, transport and communication will demand manpower to keep them working and also for improving. The education today must equip the future citizens for these tasks so that they can improve upon the existing science and technology.

B. *To Utilize the Technological Advancements Effectively*

Some people will man the scientific and technological developments but all will get the benefit of it. The utilization also demands sense for judicious use. The wrong handling o an equipment or gadget will damage it. Therefo users must have sufficient skill to handle. Th proper handling, maintenance and safety fro hazards must be known to all users. This mus combine with judicious use which demands th discriminate use. One must understand th negative side of the indiscriminate use of techno logy. The indiscriminate destruction of fores and absence of proper care, are bringing nume ous pollution problems. With the increasi growth of population and industry, unless ca is taken, all the vital resources are bound to polluted.

For a number of problems of the envir

ment, scientific or technological know-how are available. But due to various reasons people do not utilize the remedial measures and thus continue to suffer. Foi example a disease called lathyrisme is prevalent in certain regions of Madhya Pradesh, which is caused due to the intake of a kind of lentil called *Khesari* which carries a toxic substance to cause nervous disorder. A simple detoxification technique is known, but still people do not utilize it and continue to suffer.

C. To Face the Problems Methodically

The methods of science are not different from the methods of daily life. The problem arises when these methods are not followed. Lack of interest and curiosity, acceptance of everything as inevitable, false notion about authority and absence of anything to improve living are the important causes of abandoning proper methods of living. Through the education of science the children must be given opportunity to practice the methods of science so that they can develop it as habit to use it as methods of daily life. The promotion of interest and curiosity about things and occurrences in the environment, courage to question about everything that is not understood, ability to draw inference after collecting data, realization of the importance of working together and the growth of a feeling and respect for others should be the most important expected learning outcomes of science education. Such science education alone can prepare the future citizens to face the problem-stricken future world.

D. To Develop a Sense of Shared Identity with Others

The trend of the changes experienced in recent years has demanded the need of collective and cooperative action. It is not possible for any individual or any country to solve the problems. An individual's action is not enough to remove the gross miseries existing in the community. Similarly, however resourceful a country might be, it is not possible for it to tackle the problems. However equipped one might be, it would serve no purpose before the magnitude of the problems. The enjoyment of the benefits of economic development by a limited few will not last long, if majority remains deprived of it. The sense of propriety should be changed into a feeling of belongingness. While improving himself or herself, one must take care about the right of others to live respectfully. Education uptill now has created "elites" who thought themselves isolated from the rest of the community. The educated group felt little responsibility for the majority who are not educated. It has been thought that they have no experience, no ability and no need to live respectfully. A system is persisting in which "elites" are continuing to remain "elites", while majority continued to remain in the condition of utter distress. This system must be ended and that is possible only through the development of consciousness which will develop a sense of concern for all individuals, a sense of respect for all work and an awareness about the problems at the community, national and global levels.

E. To Discover, Explore and Analyse the System which are Operating in the Environment

No individual lives in an island. Each individual is a part of the system which includes family members, community members, other living organisms and the physical environment. Within such aggregation of a system, a number of interactions are constantly operating. These interactions result into change. The system is not same everywhere. There are certain uniqueness in each corner. While growing up one must understand this system—its elements, interactions and the direction of change. Such understanding is possible only if one is prepared to discover, explore and analyse the system. And these abilities can help to eliminate undesirable interactions and to replace them by desirable ones which can bring effective changes for the benefit of all.

Science Education for the Child

As the changes are caused by the developments of science and technology, the science education is a must for preparing the children to live in the changing world. All the preparations mentioned above can be attained only through the proper learning of science. For this reason like all other countries, we are also attempting to strengthen our science education.

The approach paper of 10 years curriculum has recommended the introduction of science as a compulsory subject in the first 10 years of general education. The textual materials developed on the basis of this approach paper are according to the learning ability of the age-group and with the aim to equip the child to live effectively in the environment. At the primary level attempts have been made to increase the power of observation in the child. Instead of stressing on the abstracts of science, efforts have been made to draw attention of the child to the various events in the environment where science is involved. Together with the creation of interest and curiosity, efforts have been made to create an awareness about health, nutrition and environmental sanitation. The students at this level will be attracted to science through various activities operating in the daily life situations.

The science at the middle school level (ages 11 to 14) has been presented as integrated science. The course presents primary level of integration and concepts of science have been integrated with the environment. The students of this age-group begin to form abstract ideas and seek answers to a number of questions about their observations of things and occurrences in the environment. This course has attempted to codify the experience of the child and it is expected that after learning this course the child will—(1) become curious and interested in science as well as about the things and occurrences in the environment, (2) learn to collect data and analyse them before taking a decision, (3) not to accept anything as inevitable, and (4) develop courage to question everything in daily life situations which are not understood. These are the most basic values, which if attained, will lead to the fulfilment of other objectives.

Without dividing science into physics, chemistry and biology concepts have been drawn from all areas which are experienced in the environment. Topics selected are not only from physics, chemistry and biology but also from astronomy, agriculture, health, animal husbandry and geology. In each chapter, the relevance of the topic has been discussed so that the child may understand the purpose of learning the topic. The entire course is based on activities which are of three categories—(1) to be demonstrated by the teacher, (2) to be done by the students in the class, and (3) to be done by the students in their home as well as during play. Efforts have been made to replace contrieved situations by daily life situations in the activities with this expectation that this will involve the children more intimately with the environment. Most of the activities are group activities for giving the students enough opportunity to practice working collectively and cooperatively.

On this foundation, the secondary and the higher secondary courses have been developed. Here the students will learn the abstracts of science to strengthen their understanding about its link with the environment. It is expected that this course will make the pupils aware of the problems, enthuse them to think and to take right action towards their solution. It is expected that such actions will be meticulous exploration of the system operating in the environment, finding out of the problems and a decision towards the solution of these problems. With the understanding and skills developed in the first ten years science education, the student is capable not only for higher education, but also for joining the working force in the areas of agriculture, poultry, health, technician and apprentice. It has always been kept in mind that while learning science in the first 10 years of school, the students do not loose interest in science. At the same time it is expected that natural curiosity of the child grows into an inquisitive mind. The interest will force the child to know more about science and inquisitive mind will put them to meet the problems effectively.

Hurdles to Overcome

There exists no two opinions about the changes which are going to take place in future and about the preparations needed for the future citizens. The input made at the level of NCERT in the area of science education is a small step but a significant one. The fulfilment of the desired objectives are still far off. The achievement will depend upon concrete programmes, designed to implement the science education. For this purpose, it is necessary to minimize the following three constraints which appear to be almost unsurmountable hurdles :

1. *Lack of Proper Motivation*

The success of science education as an effective tool to prepare the child for the future depends upon the commitment of the functionaries and expectation of the entire population who are the beneficiaries. Both these groups must realize about the nature of science education. The functionaries include curriculum designers, authors, educational administrators and classroom teachers and the target groups are apparently students but in reality the entire community is the target group. The desire of the parents create the social pressure on education. Therefore unless and until they are motivated to make proper expectation, there exists very little chance of the education to be improved. Two terms "modern" and "rational" which are frequently used for science education, need to be very clearly defined. Uptil now science education at the school level has been considered as prerequisite for higher education. For this reason, facts, figures, data from the contemporary state of knowledge have been given top priority. The relevance of science to daily life or the importance of science (through its product and process) to help in solving daily life problems have scarcely been given any importance in the teaching of science. Science has always been thought as to develop certain abilities and least attempt has been made to use it for desired value changes. It is necessary to device programmes which will motivate different functionaries to feel the need of teaching not the content oriented but life oriented science. At the same time, large scale programmes are needed to create an urge within the community so that it does not demand science teaching at the school, only as a preparation for the higher pursuit of science or science based technology. It means that both the functionaries and the beneficiaries will have to come forward to shape the science education for preparing the child for his total development and not partially to take part and to utilize the scientific and technological advancements. Such a change in the attitude in functionaries and the beneficiaries will help in the reduction of unnecessary content load, reduction in unnecessary expenditure and will make the science education more meaningful.

2. *Absence of Understanding About the Environment*

Any preparation of the child to live effectively in the environment demands a complete understanding of the functionaries about the different "system" which are operating in the environment. In a diverse country like ours the environment varies widely. The science curriculum developed in the centre or in the state headquarter will never reflect the "systems" which are operating in the different environment. Thus with the existing mechanism of science education development, the curriculum is bound to remain unrealistic. In order to overcome this defect, it is necessary to identify the every details in the "system" which are operating in each environment. The problems existing in the environment which demand the knowledge and skill of science should be identified. Those problemes may be related to food production, health, environmental sanitation, transport and other daily life situations. While giving thought to the existing problems, it is necessary to consider the problems which may develop in future. A science education with such linking with the environment can be developed by mobilizing the expertise available in the community. This in turn demands to fulfil the need of motivating all concerned. It means that programmes must include research surveys, orientation, changes in the school organization and examination system. In this environment linked science, it must be stressed that science education is not to provide only some facts and skills but science education is to develop certain values like interest, curiosity, awareness and courage which will play the most crucial role in bringing and maintaining changes in the community.

3. *Absence of Concentrated Effort*

Most of the present day efforts to link science with the daily life situation are isolated events. For example, in the development of instructional material, this was thought only to be done upto elementary level. The secondary, higher secondary and tertiary level of science education are still designed to teach science as a special form of knowledge. The different problem areas in the daily life situation are treated separately.

For example, some groups are concerned with nutrition, some with food production and some with health problems. There are different working groups for population education, women welfare, child welfare and community improvement. Such efforts, however, honest they might be, are ineffective because all the problems like hunger, malnutrition, disease, poor crop production, over population, poverty and exploitation are very much interlinked and should be tackled simultaneously. As stated earlier, the root causes of all these problems are : (1) people are not curious and interested to know about the things and occurrences in the environment, (2) people accept everything as inevitable and destiny, (3) people do not have the courage to ask questions on the things and occurrences which they do not understand, and (4) people do not have the confidence to work collectively and cooperatively for bringing any change. A properly designed science education is the most effective tool to hit these root causes and thus a must for preparing the child for a changing world. □

Science Education in Belgium

S. G. GANGOLI
Department of Education in Science and Mathematics, NCERT, New Delhi

1. *Introduction to Educational System*

BELGIUM IS ONE of the ancient countries in the Northern Europe. The population is about 9 million and Brussels is its capital. It is a Sovereign Republic. It has a glorious heritage of ancient art and educational institutions. One of its universities, the University of Leuven, has been a leading centre of education in Europe since the 15th century. Like many other countries in Europe, Belgium too was caught up in the two world wars and since then, there have been rapid changes in socio-economic structure and educational system. Under the combined influence of increased prosperity and growth in technology, the educational concepts in Belgium have undergone many fundamental changes and there are certain things that we in India can learn from their present educational system.

Belgium is mainly inhabited by two linguistic groups—the French speaking and the Flemmish speaking. The Flemmish language is very much akin to Dutch language, but the culture of these two peoples are different. About 60 per cent of the schools, especially in the Flemmish speaking area are run by the catholic mission. The rest are run by the government or the local administration. The main difference between these two school systems is that in the catholic schools, children are taught about catholic religion and in the official schools, they are free to learn about religion of their choice—catholic, protestant or hebrew. Some kind of uniformity in the education is maintained throughout Belgium by the Inspectorate of Schools (schools also include university). About 21 per cent of the national budget is earmarked for education in Belgium. For the last 4-5 years, there is a serious attempt by the government to modify the educational pattern. They have introduced what is commonly known as the '*Renovated Educational System*'. The catholic schools are also gradually adopting this pattern. In this article, the author is mainly dealing with the Renovated Educational Pattern.

2. *Educational Pattern*

Education is compulsory for children in the age-group 6-14. Children go to elementary schools for 6 years from age 6-12 and the secondary schools for 6 years from age 13-18. The secondary education is divided into three courses—2 years observation course, age-group 12-14; 2 years orientation course, age group 14-16; and 2 years determination course, age-group 16-18. After the higher secondary education, students go to university for their study in science, medicine, engineering, humanities and social sciences, etc. The candidate course which is equivalent to our bachelors degree takes two years after the secondary education. Their licence course which is equivalent to our masters degree takes another two years. The doctorate course takes about 5 years after the licence course.

Besides the universities, there are other institutions which run three years vocational course, which is equivalent to our diploma course in the engineering colleges.

3. *Examination System*

Each school and university evaluate their own students. Evaluation is a continuous process, carried out throughout the course. Students get admission to whatever course they are interested in but evaluation during the first year of the secondary school or university is very tough. About 50 per cent of the students are detained, so that only those who are suitable and have achieved sufficiently higher excellence are allowed to continue.

4. *Preparation of Textbooks*

The textbooks for elementary and secondary education are written by and large by school teachers. People are free to write and publish textbooks and the Ministry examines the books and prepares a panel. By and large, the teachers in universities do not participate in developing school books. As a result, there is considerable gap between the educational level in the secondary stage and the university stage and children have to study extra courses during their vacations to meet the requirements of the university.

5. *Highlights of the Science Education in Secondary Schools*

In the elementary schools, science is mainly taught through environmental studies. Science is taught, as separate disciplines, physics chemistry and biology only in secondary schools.

The theory and laboratory courses in science are taught in the same classroom. The teacher has the option to arrange his apparatus accordingly. Quite often theory and practicals are taught simultaneously.

In the observation stage of the secondary education all students have to learn the same course (age-group 12-14). The diversification starts from the orientation course. During the orientation course they have to opt between fundamental course and mixture of fundamental and technical course. The fundamental course consists of language course, technical course and science course. Broadly speaking those who opt for the fundamental course go to university education and those who opt for mixture of fundamental and technical course go to what we call in India as the vocational stream. There are a large number of options in technical course, such as, catering, secretarial, auto work, carpentry, metal work, agriculture, mining, textile, laboratory maintenance, etc.

During the determination course, children continue the studies they have opted in the orientation course. That is, they continue either with their fundamental course or with the mixture of fundamental course and technical course. The determination course is a kind of terminal course.

The pupil who opted for a mixture of technical and fundamental course readily gets a job. If they want to go for university education, they have to take some additional courses, or they can continue their education in technical colleges and get some kind of diploma.

6. *Laboratory Equipment and Laboratory Manuals*

One of the important centres linked with science education is the Centre Technique de Mons. The task of the above Centre may be summarized as follows :

(i) To list the apparatus required for the experiments.

(ii) To contact the various firms and list the availability and suitability of the apparatus.

(iii) To develop simple apparatus and to assemble certain apparatus by procuring their parts from commercial firms.

(iv) To develop laboratory manual based on these apparatus. The emphasis in the manual is on the construction and use of these apparatus and not on the classroom activities.

(v) To impart training to the teachers on the use of these apparatus and maintenance of the apparatus in the schools.

All the laboratory apparatus for about 40 per cent of the schools in the country is supplied through this institution. It has all the relevant computerized information about the laboratory apparatus in different schools.

7. *Teacher Training*

Teachers are specially trained for teaching in the nursery schools, elementary schools and lower secondary schools. Students, after completing their secondary education, seek admission for this training course. They are trained for a period of two years and the course is quite intensive and the latest techniques using close circuit television, etc. are made use of. Emphasis is also given on the actual classroom teaching.

In contrast, the teacher-training programme for the higher stage of secondary school, is not so intensive on methodology. The emphasis is laid on the content of the course. Persons who are interested in teaching higher secondary stages have to have a masters degree in the subject and they also have to have some kind of diploma in education. Though this diploma if taken separately, may be covered in one year or less, it is seldom learned separately. In practice, the candidates while doing their masters degree take these additional courses and get qualified to become teachers for the higher secondary classes.

8. *University Education*

Universities admit all students who seek admission. However, the evaluation during the first year of the course is very tough and the majority of the students drop-out of the university by the end of the first year. Some universities ensure that the students entering into courses have completed certain prerequisite courses.

The author visited Research Laboratories in Physics in the University of Gent and the University of Leuven. The general standard of research in these laboratories is very high and can be compared with the advanced centres of research in the American universities. It was interesting to note that the Dean of Faculty of Science in the University of Gent has a very large number of people working on Ramannath theory of Light Diffraction by Ultrasonics and he has requested for a photograph of Prof. Nagendra Nath for keeping in the laboratory. The photograph of Sir C.V. Raman is already prominently displayed there. This is an evidence to show their respect for an Indian scientist in Belgium.

9. *Concluding Remarks*

Only those aspects which are of immediate relevance to our science education are briefly described here. There are many other fields such as education for the handicapped, education by correspondence, etc. which are determined by the particular economic and social conditions of the country and these have not been dealt with. □

ACKNOWLEDGEMENT

I am grateful to the authorities in NCERT, Government of India and to Government of Belgium for deputing me to visit Belgium in the Indo-Belgium Cultural Exchange programme in January, 1980. I am also grateful to my colleague Dr. B. K. Jangira for the useful discussions I had with him during the course of this programme.

Postage Stamps as Teaching Aids

SHAKUNTALA BHATTACHARYA
Department of Education in Science and Mathematics, NCERT, New Delhi

MOST CHILDREN ARE great collectors. They collect anything that catches their fancy, stones, insects, matchboxes, pictures... and of course the commonest of all, stamps. Since these are the children's hobbies, therefore, they exhibit more interest and exert more effort in this field than they do in their routine studies. It is a wise teacher that channels this interest to make the teaching/learning of science more attractive to the child. Stamps attract children by their variety of colour, shape and theme from a very young age (about six or seven) and the hobby well-nurtured can last a man through his life time and provide interesting occupation on his retirement.

How can a science teacher use stamps as a teaching aid? Stamp collection always aids the development of the following skills—observation, classification and manipulation. Let us examine some of the basic ideas that can be illustrated through stamps. The first attribute that a child develops is to observe keenly the things around him. This starts with shape, colour and size.

Shape : It is interesting to note that most stamps are rectangular, some are square, very few are triangular and diamond shaped (Fig. 1). Why is it a stamp is never round? Here comes the question of printing and perforating. Stamps are commonly of certain shapes because they are printed in blocks or sheets and therefore such shapes are used that can help in packing a maximum number into an area.

Colour : In the first case the child can be taught the basic current series of values depicts the same theme in different colours. Then his attention can be drawn to the subtle difference between colours thus heightening his sense of observation and colour.

Size and perforations : Stamps offer a suitable object for practising, measuring small lengths. Given a variety of stamps of different sizes children can be asked to measure their length, and breadth accurately. Questions can be posed about the area of stamps, the range of size and the ratio between the length and breadth. Does this ratio follow any pattern? Does a country produce stamps of particular size only? (Switzerland for instance prints almost all its stamps in a particular size). If so why?

The child has by this time most probably observed that stamps have perforated edges. But why do they have perforated edges and how does this make tearing easier? These are some of the questions which a teacher may have to answer. At this stage the child may be provided with a magnifying glass and asked to observe and count the perforations (Fig. 2). Many problems may be posed which will develop his computational skill. How many perforations are there per cm? How many perforations are there on one edge? Is the number same on the parallel edge? Does this number vary in different stamps or do all the stamps of a particular issue and denomination have the same number of perforations per cm? If the stamps are of a particular size, how many stamps can fit in a sheet of a given dimension?

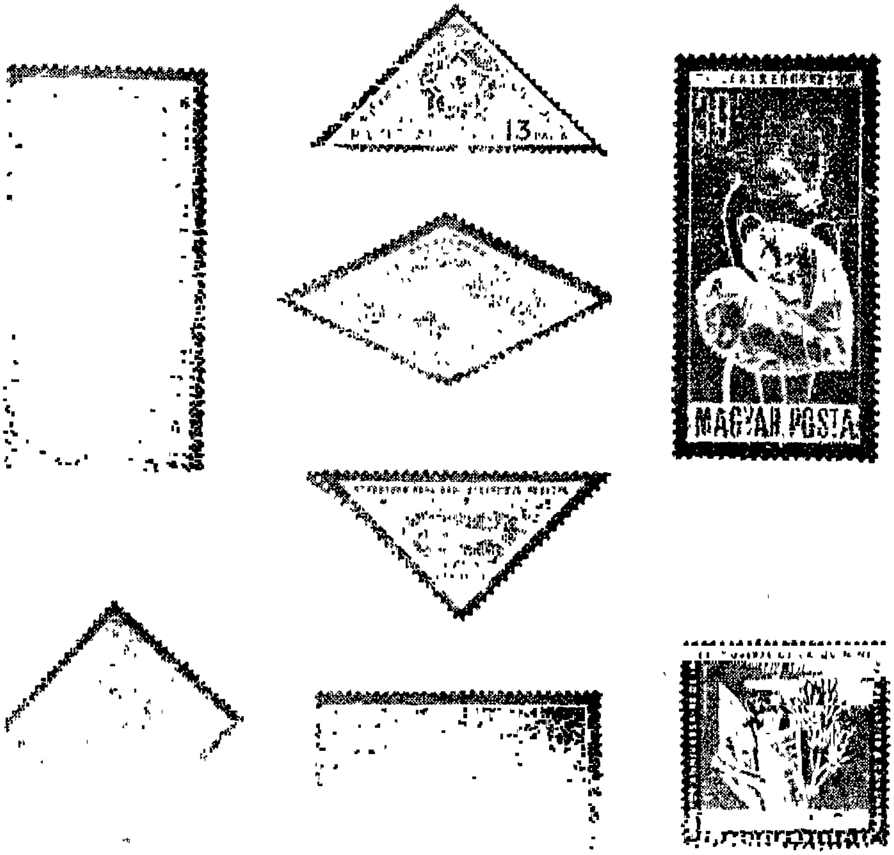


Fig. 1 Shapes of stamps

Fig. 2 Stamp showing use of magnifying glass

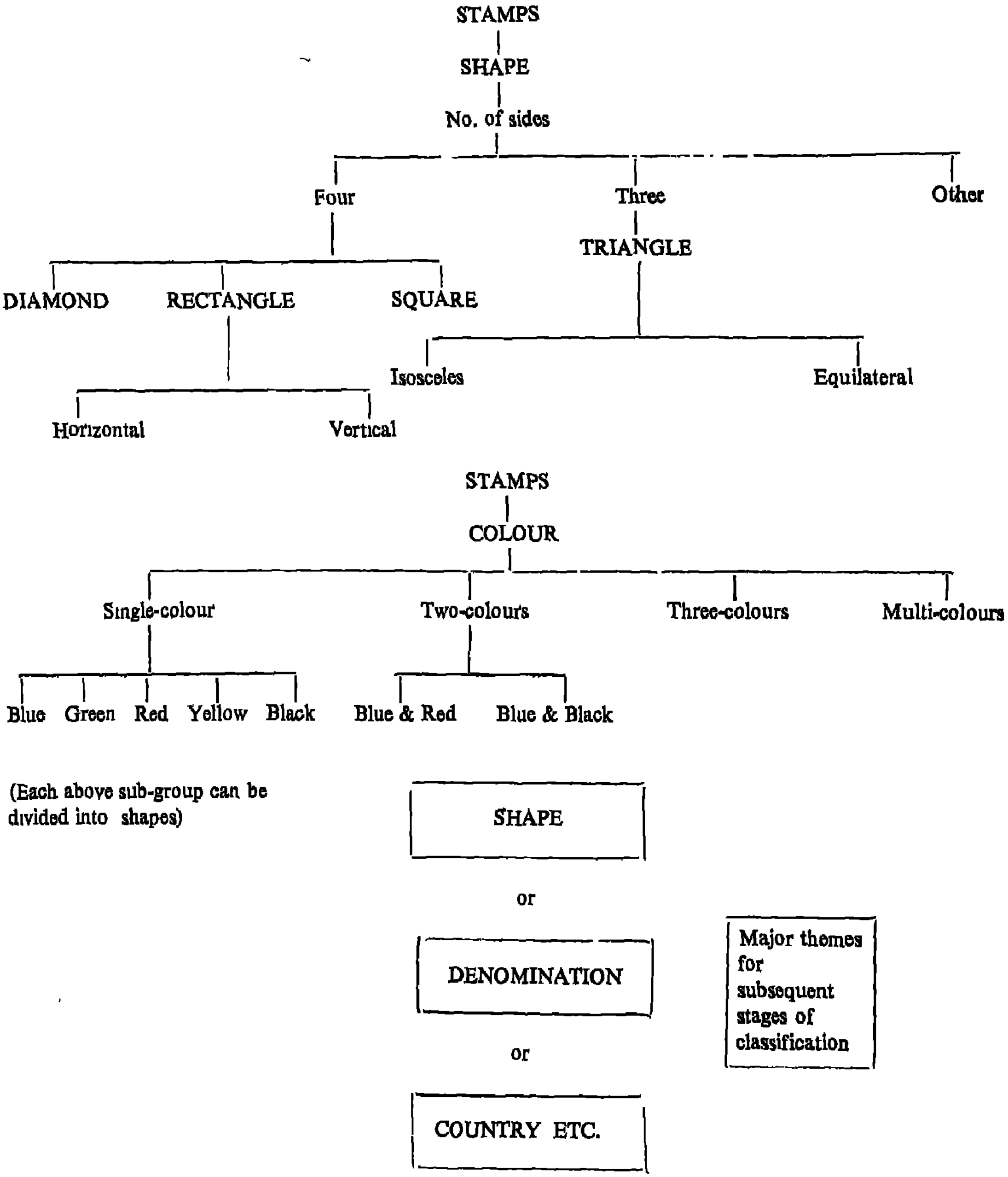
How many triangular or diamond shaped will fit on a similar sheet and so forth.

Denomination : The various denominations of stamp can also be used as a tool in the teaching of simple arithmetic.

Classification : Having gone into shape, size and colour, the child can also be taught the ideas about classification using a bunch of stamps. How many different ways can they be classified—colour, size, shape, denomination and country-wise. Here he can be taught that the number of groups vary according to the criteria of classification and each group can further

TABLE 1

Use of Stamps for Teaching Classification



(Each above sub-group can be divided into shapes)

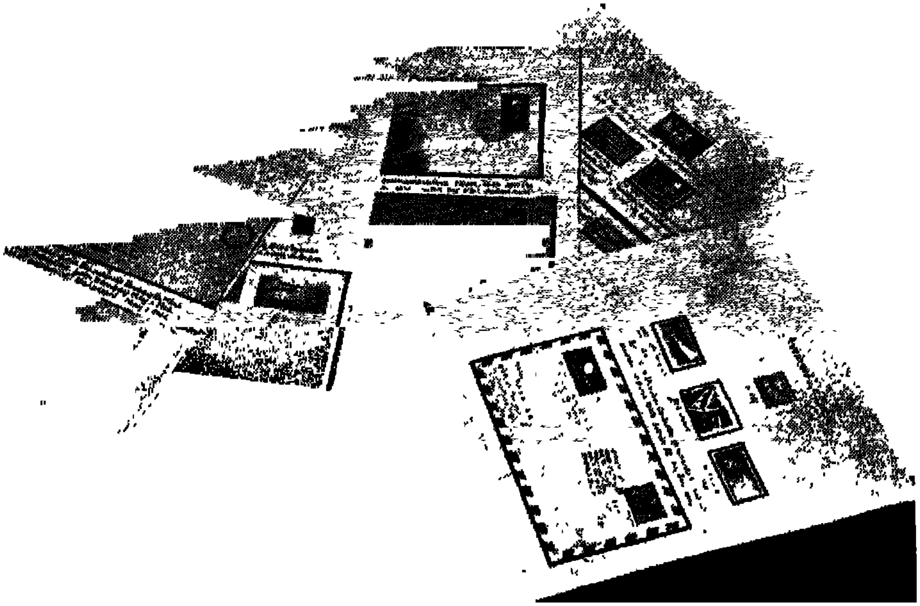


Fig. 3 A display of pages from a loose leaf album

be divided into sub-groups based on another criteria, and such classification helps in the quick identification of a subject (Table 1).

Manipulative Skills: If a child is encouraged to collect using proper care that the stamps are not mishandled, he will develop some manipulative skills especially as regards using tweezers and the magnifying glass (Annexure I). Stamp collectors often use lenses of the multiple type, and attention can be drawn to the fact that using a number of lenses needs readjustment of the focal length and also gives a larger image. At this point further observational skills could be developed—as much as the child may be asked to compare the printing on stamp with that of a bank note as well as paper and water marks. He will also learn to handle delicate objects with confidence.

Thematic Collections and their Use

These are but general things that a child can be taught through his stamp collection, however the themes on the stamps offer a wide scope for some teaching aids in specific areas. If one looks critically at the themes, one finds that the flora, fauna, agriculture, natural resources, scientific and technological achievements, scientists and technologists of most countries are depicted on their stamps.

Taking the above into consideration, teaching aids using stamps can be developed which uses stamps for a specific discipline like biology. As such certain charts can be developed which uses stamps instead of drawings and photographs, because reproductions on stamps are often more authentic than ordinary drawings. At this stage it should be pointed

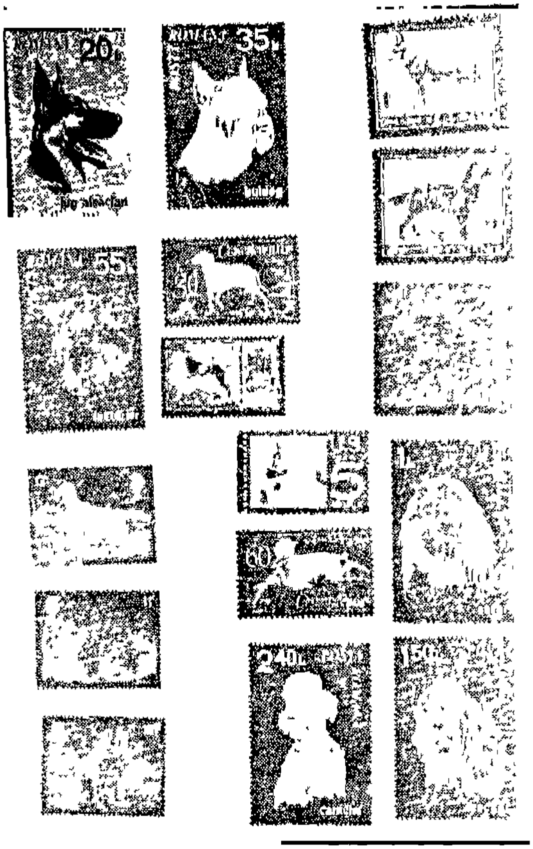


Fig. 4 A collection displaying variation within species in dogs

out that damaged stamps, which have no philatelic value may be well put to use for such purposes and may be less costly and more easily available. Some charts are outlined below and the teacher may use his resources and imagination to design many more from the vast wealth of themes available.

The flora, fauna, agricultural products, and natural resources may be illustrated by using the stamps of a particular country and passing them in appropriate positions where they occur. On a larger scale a world map may be used to illustrate the same ideas and children could be encouraged to go on adding to it. Diversity of plants and animals in the world may form the basis of charts, with an attempt to add as many different types as possible as time goes on. The stamps should be supplemented by a short write-up including scientific names, habitat, peculiarities, etc. The material thus developed need not necessarily be made up into charts, but can be preserved as a loose-leaf album through which children can browse through their spare time (Fig. 3). As a sequal to diversity, one can visualize illustrating classification of animals and plants though it may be difficult to secure stamps with micro-organisms depicted on them. It is also possible to build up an evolutionary tree using stamps as illustrations, however as has been pointed out earlier, stamps on lower organisms may pose some problems. Variation within a species for instance can be illustrated using stamps on dogs or horses or human beings (Fig. 4). Plants of economic use can form the basis of a series and these can be divided according to medicinal plants, fruits, fibre yielding plants, etc.

Such displays should be made using a black or dark background. Stamps should be mounted using hinges if the stamps are to be re-used or has philatelic value, or else if they are damaged they can be directly pasted on. After mounting, the sheets can be sealed into plastic bags along with a piece of cardboard backing as stiffner. Such sheets can easily be handled by children without damage.

It is rather easy to design teaching aids in biology from stamps, as a large array of stamps of biological interest are available. This does not mean that other subjects like physics, chemistry, geology, etc. cannot be successfully tackled. As a matter of fact, a large number of applied science topics can be touched upon and discussed, while one is narrating how stamps are designed, manufactured and distributed. The book *Romance of Postage Stamps* published by National Book Trust, New Delhi, may provide useful reference material for

ACCESSORIES FOR COLLECTING STAMPS

(1) *A pair of tweezers*—nickel or chrome plated with round or spade-shaped ends are best.

(2) *A watermark detector*—A difference in water-mark can be an important factor in determining the rarity of a stamp. A black trya or tile, on which the stamp is placed face downwards ordinarily makes the water-mark visible. In different cases petrol poured on the stamp reveals the most recalcitrant water-mark.

(3) *Magnifying glass*—Whatever type glass is chosen it is best to remember that if a stamp is to be inspected closely the amount of surface which can be seen must be small. That is why a reading glass is quite unsuitable for stamps.

(4) *Hinges*—These are small rectangles of a special thin but tough paper with a double coating of gum, so that when they dry they peel off easily from the back of the stamp.

(5) *Albums*—These are books into which stamps may be mounted, loose leaf albums which can be added to as the collection grows are the best buy.

THE PHILATELISTS JARGON

Perforations : Holes punched between stamps to facilitate tearing. The gauge of the perforation is measured by the number of holes in space of 2 cm Hence Perf. 12½ or Perf 15 denotes the number of holes in that space

Water-mark : The thinning or thickening in the form of a design, in the substance of paper, deliberately caused while it is being made.

Mint : In the best state of issue, with original gum on the back.

Unused: In the state of being uncancelled or otherwise undefaced: 'unused; often signifies the original gum has been lost.

Cancellation : A defacement (postmark, signature, or holes) made by authority on a stamp, to prevent re-use and also to indicate place and time of posting.

Set : A collection of single examples of different values in an issue.

Block : An unseparated group of three or more stamps in more than a single column or row and comprising less than a sheet.

First-day covers : A cover bearing stamp or stamps used and postmarked on the first-day of issue.

Folders : Descriptive write-ups accompanying each commemmorative, which besides giving the vital statistics of the stamp, e.g. colour, size, perforation, etc. also gives in a nutshell the history of the event which it commemorates.

TYPES OF GOVERNMENT ISSUED STAMPS

Definitive : A postage stamp issued for normally permanent use, and contrasted with provisionals commemoratives and other issues made with a particular object subsidiary to the collection of postage (and sometimes revenue).

Commemorative : A postage stamp issued to mark the occurrence of some event or anniversary and bearing facial indication of that reason for issue.

Charity stamp : A postage stamp of which the charge is in excess of postage is devoted to a named charity or relief.

Provisional : A makeshift postage stamp issued for temporary use; the expedient often adopted is to surcharge or overprint another postage stamp.

Special service stamps : A class which included airmail, express delivery, late fee and similar issues.

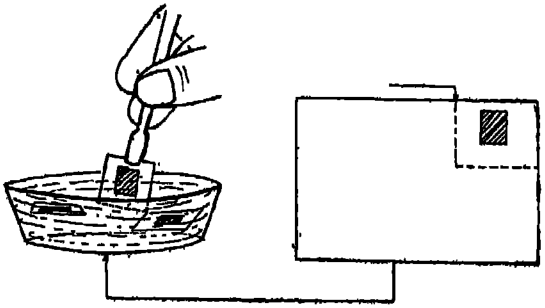
Officials : Postage stamps intended for use on mail by government departments.

Fiscal : A stamp used for collecting non-postal taxes.

ANNEXURE I

Steps in Mounting Stamps

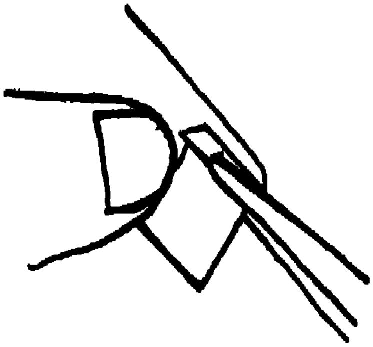
1. Select undamaged stamps—cut the envelop leaving a margin.



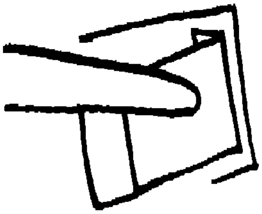
2. Place the stamps in a dish or tray full of cold water, push them down and when completely soaked, separate them from the paper

3. Dry in air, and place between the pages of a book for flattening for a few days

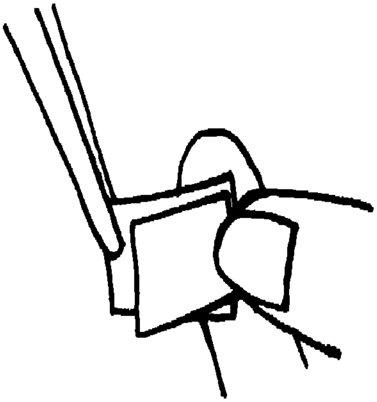
4. Mount the stamps as shown below :

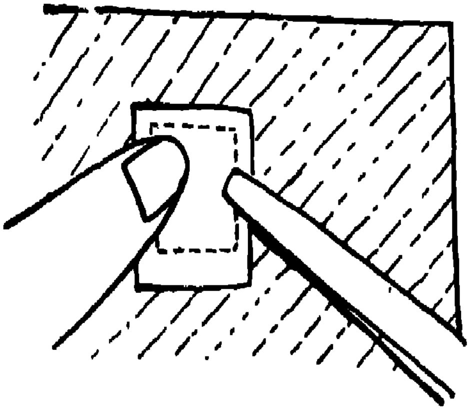


Fix shorter end on stamp just below perforation.



Fold hinge unequally (1/3 to 1/4 from top edge) with gum side outward.





Affix stamp to the album page by sticking on the broader section of the hinge. Do not use too much water to moisten.

teachers. Some other articles of interest are listed below.

One should be encouraged to collect stamps not only for their philatelic value, but also to learn about themes depicted on these stamps. Thematic collection helps us developing certain basic attributes. For instance, some years ago I saw some very interesting thematic displays by children in a philatelic exhibition. One was on the development of air travel, a second one was on ships and a third on just different modes of travel. In the short write-ups the exhibition had not only mentioned the date and country of issue and the occasion but had also done enough reading to write a few lines on the scientific aspect. No doubt the child's main interest was in stamps, but in choosing to develop such a theme through stamps must have led to much enquiry and reference hunting to write it up. He had probably taken his first steps in a research activity, curiosity had led him to search for available materials and literature. Such hobbies, if encouraged, not only leads to the development of a scientific outlook but provides one of the best self-learning material. The teacher also benefits in as much as he can draw on this material as a teaching aid, and on the knowledge gained by the child. The various aspects of science and technology illustrated through stamps can form the basis of science club projects and science exhibition displays. Finally, why not try to encourage creativity by asking the class to design a stamp to commemorate a special scientific event.

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The Mechanism of Nerve Conduction

S. Srinivasa Raghavan and C.A.P. Rao
Regional College of Education
Bhubaneswar

Introduction

It is our common experience (also of the animals) that we (they) are aware of the external environment through the external receptors. These receptors are sensitive to various kinds of stimuli. For example, the eyes are sensitive to light and the ears to sound. Information from the receptors is communicated to the central system of brain and spinal cord from which instructions are sent to appropriate effectors (organs like muscles) so that some action can be taken to respond to the environment. An example is seen in a feeding cow. The image of the edible object is projected by the lens on the retina of the eye and this stimulates the retinal receptors which produce a series of signals to be sent over the optic nerves to the brain. One portion of the brain receiving the visual impulses interprets them as a picture, and in the light of experience or by instinct, the animal recognizes the edible object. Now, impulses are sent from the brain over other nervous pathways to muscles causing them to contract and relax systematically, so that the cow walks over to its food.

The eyes and muscles are external receptors and effectors respectively, since they are concerned with the response to external environment. Similarly, there are also systems of internal receptors and effectors which control the internal environment. The pressoreceptors in the arch of the aorta which keep the cardiac centres of the brain informed about the blood-pressure is a classical example for the above statement. For both the external and the internal changes the pattern of responses is similar. In both cases (a) a sensitive organ is stimulated by the change; (b) signals from that organ travel to the central nervous system where they are "interpreted"; and (c) signals are sent over other pathways to muscles or other effectors which can do something about the change. An essential part of these activities is *communication,* and this is what is typically achieved by the nerves.

Description of the Nerve Cells

The cables by which the communication is established with the brain are chains of cells known as *neurons* or nerve cells. The body of each cell is attached to a long thin extension known as the *axon* which terminates in a nerve ending (Fig. 1). Each connection to a subsequent neuron is made through a synapse. The living cell has fluids both inside and outside (called intracellular and extracellular fluids, respectively). In most organisms, especially high animals, the extracellular fluid is high in sodium and low in potassium. The intracellular fluid has the reverse characteristics. (It is to be pointed out that apart from sodium and potassium, chloride and calcium are present in the external fluid and magnesium and phosphate in the internal fluid. However, sodium and potassium play a dominant role in the nerve conduction). Thus there is an unequal distribution of these electrolytes and the separation between them is a surface called *membrane.*

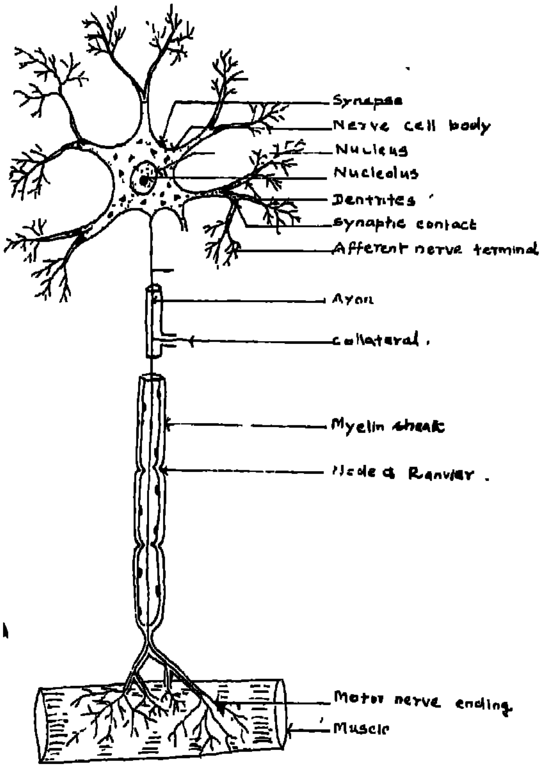

Fig. 1 Diagram of a nerve cell with some of its synaptic and neuro-muscular contracts.

Sodium Pump and the Electric Potential in the Nerve Cells

Under normal conditions the membrane allows neither the potassium ions to go out of the cell nor allows the sodium ions into the cell. Obviously, it is relevant here to inquire as to how the nerve cell manages to hold down its concentration of sodium ions against the combined forces of diffusion and electrical pressure. It is believed that the steady state of the resting cell is maintained at the expense of a continuous "basal metabolism", technically known as *sodium pump*. In this, the sodium ions are driven out of the cell as fast as they enter.

Fortunately, the rate at which sodium ions tend to leak in through the membrane is extremely low, so that the energy required (by the sodium pump) to pump them out is small. The energy for the pumping process is expected to come from Adenosine Triphosphate (ATP) which is located in the cell surface.

In general, electric potential differences appear at the boundaries between two electrolytes solution if there are ions of different mobility or concentration on either side. Since in a nerve cell we are having a similar situation i.e. sodium ions and potassium ions are separated by a membrane, an electric potential is created across the membrane. The potential difference (E) in such cases can be calculated using the Nernst equation:

$$E = \frac{RT}{F} \log \left(\frac{C_2}{C_1}\right) \frac{u-v}{u+v}$$

Where R is the Universal constant
T is the absolute temperature
F is the electric change per gram equivalent of univalent ions

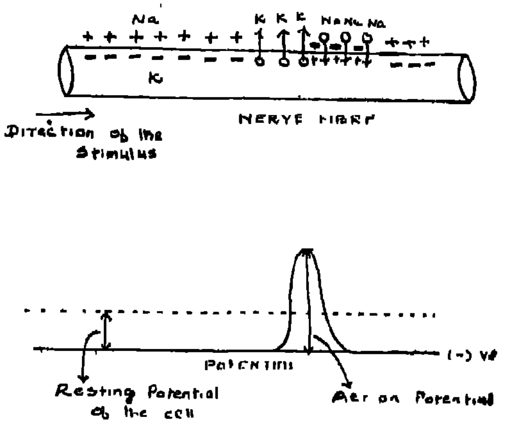

Fig. 2 Action potential wave spreads along the surface of a nerve fibre. During the rise of the action potential sodium ions enter the fibre and make it positive. During the resting state of the nerve the outward pressure of potassium ions keeps fibre interior negative.

C_1 and C_2 are the salt concentrations on each side, or more correctly, the geometric mean activity of the two ions, and u and v are the mobilities of ions. In the normal state, the inside of the cell is more negative than the surrounding fluid. This is because, the potassium ions inside the cell tend to diffuse out but are held in electrostatically by the organic negative ions which cannot pass out through the membrane. On the other hand, the sodium ions cannot enter to make up for any deficit of positive charges inside the cell.

Electrical Conduction in the Nerve

Whenever there is a disturbance to the steady state of the nerve cell (example: sound waves falling on the ear drum which in turn affects the nerve cells) a stimulus acts by disrupting the equilibrium of the nerve membrane resulting in a sudden increase in ions permeability. In other words, the membrane seems to become more permeable to positive sodium ions as a result of which sodium ions begin to flow inward and reduce the negative charge inside the cell. Similarly, the potassium ions migrate outwards. As the sodium permeability continues to rise, more sodium enters thus increasing the positive charge inside. This sodium flow continues until the cell interior becomes largely positive that sodium ions are now electrostatically repelled. Thus, after the stimulus passes over this region, the cell returns to its original state. Looking at Figure 2 one can understand the sequence of events. We have said that because of the stimulus the equilibrium of the nerve membrane is disturbed and the membrane becomes permeable to sodium ions. This in fact affects the electrical field across the membrane leading to a sudden collapse of the field. Technically this is called "depolarization" of the charged membrane. Thus, the change in the potential (see Fig. 2) at one point affects the subsequent points on the membrane and so the wave of depolarization spreads from the point of stimulus. This way the signals are propagated along the axon. To our fortune nature has provided a mechanism for increasing the speed of nerve transmission. The nerve axons are surrounded by an electric insulating jacket called *myelin*. However, this insulation is interrupted periodically along the axon by nodes (called the nodes of Ranvier) (see Fig. 1) where the nerve membrane is exposed. When a nerve impulse travels along such a myelinated nerve, the current jumps from one node to the next thereby speeding up the propagation. The velocity of the impulses along the fibre is estimated to vary from 10 m/sec to 90 m/sec, depending on the nerve fibres taken from different animals.

Transmission of the Impulse from the Nerve to Muscle through Chemical Conduction

Now, the impulses (or current) conducted through the nerve fibre have to affect the effector muscle. It has been found that there is a structural discontinuity in the nerve-muscle (called neuro-muscular) system. This discontinuity is called the "synaptic" gap. Because of this gap the electrical impulses cannot be effectively transmitted to the muscles. Sir Henry Dale and his co-workers (1936) have found that a chemical process takes place at the neuro-muscular junction. They showed that the chemical acetylcholine (Ach) is released at the nerve ending (when the nerve is stimulated) and this chemical substance has a potent stimulating action on the skeletal muscle (For more details see reference 2).

Now we explain as to how the nerve cell activity is inhibited after the "action". The axon running from the lower motor neuron gives off, what is known as collateral branch (see Fig. 3)and this branch connects the Renshaw Cell. After the impulse reaches the nerve ending it is propagated backwards and passes through

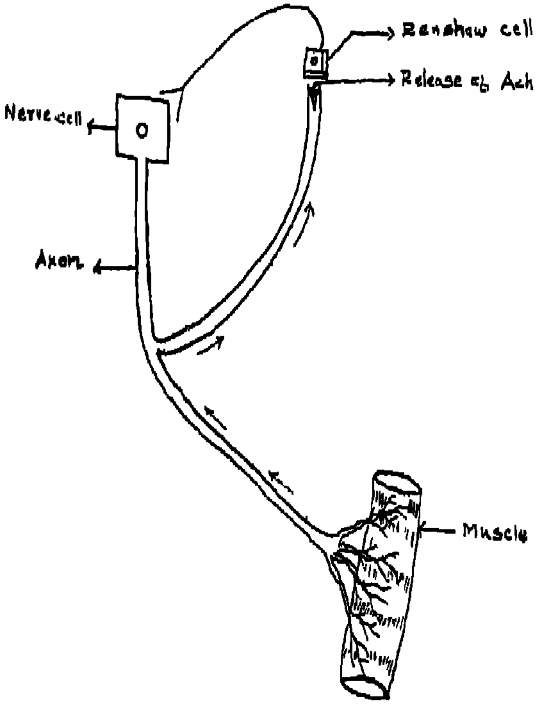

Fig. 3 Collateral branch. Arrows indicate the path of the "reflected" stimulus which comes from the neuro-muscular junction.

the branch to the Renshaw Cell, as shown by the arrows in the figure. (You can think of an analogy here: when you pluck a stretched string fixed at the ends, you observe that the disturbance travels as a wave from one end to the other end and travels backwards). Thus, the "reflected" impulse causes stimulation in the Renshaw Cell by releasing Ach from the collateral endings, and this inturn inhibit the neuron.

Conclusion

Thus, we find that the mechanism of the nerve conduction is really remarkable. In a human being we observe that the messages are transmitted to all parts of the body in a small fraction of a second. Yet, nature has produced this elaborate and efficient signalling system in a most peculiar and implausible way: it is a system built up in minute spaces containing mostly water and completely free from electric wires or the like.

We have also explained as to how the electrical impulses conducted by the nerves are transmitted to the muscles. If for some reasons the receptors in the muscle do not coordinate with the chemical conduction then muscular diseases like Myocenia result.

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Danger of Improper use of Mathematical Results, Formulas and Symbols : Algebra

S. C. Das
Department of Education in Science and Mathematics, NCERT, New Delhi

1. Introduction

Mathematics education has two aspects: the first deals with how to teach and the second with what to teach. The first aspect is concerned with the methodology of teaching mathematics, the "how and why" of learning process, the discussion of the objectives of learning mathematics, preparation of question bank, teachers' guides and so on. The second aspect deals mainly with the content, i. e. the subject matter of mathematics. In actual practice, teachers are often found to be giving more attention to the first aspect. It appears that the second aspect of mathematics education has not been paid so much attention resulting in students' getting wrong notions and concept in the content area. Since in teaching mathematics to the students, only manipulatory aspect has generally been emphasised, mathematical rules, formulas, theorems, etc. are mechanically memorised by the students without giving importance to the aspects—the language, the thought process and the logic of the subject. As a result, students sometimes get used to mathematical results, formulas, etc. without giving a thought to their validity and restrictions on them, if any, thus arriving at some fallacious results and mistakes for which they hardly find proper explanation.

In a series of articles of which this is the first, these types of improper use of results, formulas, etc. from various branches of mathematics and their consequences will be discussed with the help of examples.

2. Laws of indices

From the laws of indices, students know that if $a^x = a^y$, then $x = y$.

Also if $a^x = b^x$, then $a = b$.

Now, a student of even plus two stage may perhaps become puzzled and cannot explain the reason when he is asked the following questions :

Since $a^x = a^y \Rightarrow x = y$,

hence $1^1 = 1^2 = 1^3 = 1^4 \ldots$

$$\Rightarrow 1 = 2 = 3 = 4 = \ldots$$

i. e. all numbers are equal—a result which is absurd. What is the reason of getting this absurd result?

Again, since $a^x = b^x$

$$\Rightarrow a = b,$$

hence $1^0 = 2^0 = 3^0 = 4^0 = \ldots = 1$

$\Rightarrow 1 = 2 = 3 = 4 = \ldots,$

which is again an absurd result.

Why is this absurd result obtained?

Teachers generally don't mention or emphasise the restrictions involved in the above formulas of indices. In fact, these formulas are not true for all values of x, y or a, b. The formula $a^x = a^y \Rightarrow x = y$, for example, is valid when $a \neq 0$ and $a \neq 1$ and the formula $a^x = b^x \Rightarrow a = b$ is true only when $x \neq 0$. Most of the school students are not aware of these facts. We thus see that we get these absurd results due to the fact that we are not considering the limitations of the algebraic formulas. This is an example to show how the wrong use of a formula may lead one to get an absurd result.

3. Inequations

In solving an inequation of the type $x^2 \geqslant 1$, most of the students follow a wrong method to get the solution as $x \geqslant \pm 1$, which is wrong. Teachers generally don't emphasise this type of mistake. That $x \geqslant -1$ is wrong is obvious, since $x = 1/2$ (which is > -1) does not satisfy the inequation $x^2 \geqslant 1$. The correct solution will be $x \geqslant 1$ or $x \leqslant -1$, which can be obtained in the usual way of solving a quadratic inequation, i. e. by bringing 1 on the left side and factorising the expression on the left. Similarly, the solution of $x^2 \leqslant 1$ can be obtained in the above manner and not by merely taking the square root on both sides.

Sometimes students have the tendency to write $ad > cb$ or $bc > ad$ from the inequation $a/b > c/d$, without considering the signs of a, b, c and d. This is so because students are not generally warned by the teachers against this type of mistakes. In fact, we can write $ad > cb$, if b and d are of the same sign whatever be the signs of a and c. If, however, b and d are of opposite signs, then $bc > ad$ is true. This is because we can multiply (hence divide) both sides of an inequation by a positive number without changing the signs of inequality and without affecting its solution.

The words "inequation" and "inequality" are sometimes wrongly treated as synonymous. The difference between these two is analogous to that between an equation and an identity. An inequation is satisfied by a particular set of values of the variables involved, whereas an inequality is true for all values of the variables. Thus $x + y \leqslant 1$ is an inequation, but $x^2 + y^2 \geqslant 2xy$ is an inequality. We "solve" an inequation whereas we "prove" an inequality. Thus, the usual question like "solve the inequality" is insignificant in the sense that every inequality involving a number of variables may have any arbitrary solution.

4. Modulus Sign

Teachers sometimes give a wrong definition of modulus (absolute value) of a number. They generally explain the idea in the following way:

The modulus of a number means its positive value. Hence to get the modulus of a negative number, one should just remove the negative sign before it. The modulus of a number without any negative sign before it, is the number itself. Thus $|-2| = 2$, $|-x| = x$, $|x| = x$, etc. But the above concept is wrong in the sense that the rule is not applicable in the case of an algebraic number expressed by a variable. For example, if we assume that $|-x| = x$, then putting $x = -2$, we get $|2| = -2$, which is absurd. Again, if $|x| = x$, then also $|-2| = -2$ when $x = -2$. But this is also absurd. Thus, the correct and the most general definition of the modulus of any number, say x, is as follows :

$$\begin{aligned} |x| &= x \text{ if } x \geqslant 0 \\ &= -x \text{ if } x < 0. \end{aligned}$$

5. Logarithm

We sometimes use the formulas of logarithm without paying much attention to the restrictions involved in these formulas. As a result, we arrive at some absurd results due to this improper use of the formulas of logarithm.

For example, when we use the formula

$$\log_b m^n = n \log_b m$$

in some computation, we do not generally pay any attention about the signs of m, n and b.

Now, consider the following example : Using the above formula, we have

$$\log_{10} 16 = \log_{10}(-4)^2 = 2 \log_{10}(-4)$$

Also, $\log_{10} 16 = \log_{10} 4^2 = 2 \log_{10} 4$

$$\therefore \log_{10}(-4) = \log_{10} 4$$

$$\Rightarrow -4 = 4$$

$$\Rightarrow -1 = 1$$

$$\Rightarrow -2 = 2,\ -3 = 3,\ -4 = 4, \text{ etc.}$$

Thus, all positive numbers are equal to all negative numbers, which is obviously absurd. This absurd result is due to the improper use of the formula $\log_b m^n = n \log_b m$. It should be noted carefully that we can use this formula only when m (hence m^n) and b are positive and n is any real number.

Similarly, in the definition of $\log_n m$, we restrict m and n to be positive. If we are not careful about these restrictions, we may again come across with absurd results. For example,

$\log_{-1} 1 = 2$, since $(-1)^2 = 1$.
Also, $\log_{-1} 1 = 0$, since $(-1)^0 = 1$.

$\therefore$ $2 = 0$, which is absurd.

Consider another example :

We have $\log_{-1}(-1) = 3$, since $(-1)^3 = -1$.
Also, $\log_{-1}(-1) = 5$, since $(-1)^5 = -1$.

Hence $3 = 5$, which is again absurd. All these absurd results are due to the wrong use of the definition of $\log_b m$. In fact, the definition is based on the fact that both m and n must be positive.

In this connection, it can be stated that some students treat the numbers like $\bar{1}.235$ and -1.235 as synonymous. In simplifying an arithmetic expression with the help of a log table, a student may get an equation like $\log x = -1.782$ where x is the simplified value of the expression. He then sees antilog table for .782 and adjusts the decimal point to get the answer. But this procedure is completely wrong. The fact is that -1.782 and $\bar{1}.782$ are different. $\bar{1}.782$ means $-1+.782$ i.e. $-.218$ which is obviously different from -1.782.

The correct procedure to find x is, therefore, to make the mantissa part positive. The characteristic part may be positive or negative.

Thus $\log x = -1.782 = -2 + (2 - 1.782)$
$= -2 + .218 = \bar{2}.218$.

Hence, to get x, we should see antilog for .218 and adjust the decimal point. This type of common mistakes by many students should be brought to their notice by the teachers.

6. Binomial Expansion

In the binomial expansion of $(1+x)^n$ where n is a negative integer or a fraction, we very often use the formula of the expansion without paying heed to the restrictions on x. We thus write

$$(1+x)^{-1} = 1 - x + \frac{x^2}{2!} - \frac{x^3}{3!} + \frac{x^4}{4} - \ldots \text{to} \infty$$

$$(1-x)^{-1} = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \frac{x^4}{4!} + \ldots \text{ to } \infty.$$

Students memorise these formulas without thinking whether these formulas are true for all values of x or not. Now, observe the danger of the wrong use of the above-mentioned formulas.

Putting $x = 2$ in the formula

$$(1-x)^{-1} = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \ldots \text{to } \infty,$$

we get

$$(1-2)^{-1} = 1 + 2 + \frac{2^2}{2!} + \frac{2^3}{3!} + \ldots \text{ to } \infty$$

$$\text{or, } -1 = 1 + 2 + \frac{2^2}{2!} + \frac{2^3}{3!} + \ \ldots \text{ to } \infty$$

Left hand side is a negative number and the right hand side is a positive number and these two are equal, which is absurd. This absurd result is due to the fact that the above expansion formula is not valid for $|x| > 1$. In fact, when n is a negative integer or a fraction, the binomial expansion of $(1+x)^n$ is valid only when $|x| < 1$. This fact should be emphasized by the teachers in their classes.

7. Cancellation of a Common Factor from an Equation

In solving an algebraic equation, the natural tendency of most of the students is to cancel the common factor from both side without giving a thought whether the value of the factor may be zero or not. This type of wrong practice is very common among many students, because teachers generally do not emphasize the danger of dividing a number by zero. Cancellation of a common factor from both sides of an equation means dividing both sides by that factor. Now, if this factor is zero, then we are not allowed to divide by it, for division by zero is meaningless in mathematics.

Consider the following problem :

Solve completely the following equation :

$$x^3+x^2-4x=0$$

Students generally solve the equation as follows :

Dividing both sides of the equation by x, we get

$$x^2+x-4=0$$

$$\Rightarrow x=\frac{-1\pm\sqrt{1+16}}{2}=-\tfrac{1}{2}\pm\tfrac{1}{2}\sqrt{17}.$$

But the above solutions are not the only solutions. $x=0$ is also a solution of the given equation. Students will naturally miss this solution due to the fact that they have already divided both sides of the equation by x; in other words, they have unconsciously assumed the fact that $x\neq 0$ – an assumption which is not justified.

The correct method of solving the above equation is as follows :

From the given equation, we have

$$x\,(x^2+x-4)=0$$

$\therefore$ Either $x=0$ or, $x^2+x-4=0$.

The solution of $x^2+x-4=0$ has already been shown above.

Curious students may ask a natural question. If zero is treated to be a number, why is a student not allowed to divide a number by zero? To answer this question, teachers can give many examples to show that division by zero leads one to get absurd results in mathematics. One of many examples is as follows :

We know that the statement

$$x^2-x^2=x^2-x^2$$

is always true.

The above statement implies

$$x\,(x-x)=(x+x)\,(x-x)$$

Dividing both sides by $x-x$, we get

$$x=x+x$$

or, $x=2x$ or, $1=2$ (!)

This absurd result is due to division by $x-x$ which is zero as well as by x which may also be zero.

8. Extraneous Solution

In solving algebraic equations, students are satisfied if they get some solution of the equation by applying the usual methods. They hardly verify whether the solutions obtained satisfy the given equation/equations or not. As a result, they may sometimes get a wrong solution.

Consider, for example, the equation :

$$\sqrt{2x-1}+\sqrt{x}=2 \qquad (1)$$

where positive values of the square roots should always be taken.

Squaring both sides of the equation (1), we get

$$3x-1+2\sqrt{2x^2-x}=4$$

$$\Rightarrow 2\sqrt{2x^2-x}=5-3x$$

Squaring again, we get

$$4\,(2x^2-x)=25+9x^2-30x$$

$$\Rightarrow x^2-26x+25=0$$

$$\Rightarrow (x-25)\,(x-1)=0$$

$$\Rightarrow x=25 \text{ or } 1.$$

Hence, the solutions obtained should be $x=25$ and $x=1$. But if we put $x=25$ in (1), we see that it does not satisfy this equation. Hence, $x=25$ cannot be the solution and $x=1$ is the only solution. The solution $x=25$ which is called the extraneous solution should always be discarded. Teachers should make it clear to the students that this type of extraneous solution may be found in solving equation involving square roots and hence students should always verify the solutions by substituting these in the original equation.

9. Consistency and Inconsistency of Dependent Equations

Students know that a system of equations having no solution is inconsistent and if one equation is obtained from the other by multiplying by a constant, then the two equations are dependent From this, they may conclude that two dependent equations are inconsistent, which is wrong. Teachers should emphasize the fact that two dependent equations in fact represent the same equation. These equations will have either one (in case of one variable) or infinite number (in case of more than one variable) of solution. Hence, two dependent equations are always consistent. On the other hand, two inconsistent (linear) equations involving two variables x and y represent two parallel lines which can not meet together at a finite distance from the origin.

10. Determinants

In finding the value of a determinant of any order, students sometimes make wrong use of the operations with the elements of rows or columns of the determinant.

Students are familiar with the following theorems :

Theorem 1 : The value of a determinant is unaltered if to each element of one column (or row) is added a constant multiple of the corresponding element of another column (or row). The following is the extension of the above theorem :

We can add multiples of any one column (or row) to every other column (or row) and leave the value of the determinant unaltered.

The practice of adding multiples of columns or rows at random is liable to lead to error unless each step is checked for validity by appeal to the following theorem :

Theorem 2 : The determinant of order n

$$\begin{vmatrix} a_1+A_1 & b_1+B_1 \;\cdots\cdots & k_1+K_1 \\ a_2+A_2 & b_2+B_2 \;\cdots\cdots & k_2+K_2 \\ \vdots & \vdots & \vdots \\ a_n+A_n & b_n+B_n \;\cdots\cdots & k_n+K_n \end{vmatrix}$$

is equal to the sum of the 2^n determinants corresponding to the 2^n different ways of choosing one letter from each column.

Now consider a third order determinant :

$$\Delta = \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix} .$$

One of the curious errors into which one is led by adding multiples of rows at random is a fallacious proof that $\Delta=0$ whatever a_i b_i c_i $(i=1,2,3)$ may be. For example, in the above determinant, subtract the second column from the first, add the second and third columns and add the first and the third columns. We thus get

$$\Delta = \begin{vmatrix} a_1-b_1 & b_1+c_1 & c_1+a_1 \\ a_2-b_2 & b_2+c_2 & c_2+a_2 \\ a_3-b_3 & b_3+c_3 & c_3+a_3 \end{vmatrix}$$

which is always zero. For,

$$\Delta = \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix} - \begin{vmatrix} b_1 & c_1 & a_1 \\ b_2 & c_2 & a_2 \\ b_3 & c_3 & a_3 \end{vmatrix},$$

all other determinants being zero.

Hence,

$$\Delta = \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix} - \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix} = 0.$$

Thus we have shown that whatever be the elements of the determinant, the value of the determinant is zero—a result which is absurd. We can also proceed in the following way to show this absured result :

$$\Delta = \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}$$

$$= \begin{vmatrix} a_1-a_2 & b_1-b_2 & c_1-c_2 \\ a_2-a_1 & b_2-b_1 & c_2-c_1 \\ a_3 & b_3 & c_3 \end{vmatrix}$$

(Subtracting the elements in the second row from those in and then subtracting the elements is the first row from those in the econd)

$$= - \begin{vmatrix} a_1 - a_2 & b_1 - b_2 & c_1 - c_2 \\ a_1 - a_2 & b_1 - b_2 & c_1 - c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}$$

$=0$, the two rows being identical.

All these fallacious results are due to the fact that we have wrongly used the theorems stated above. In fact, when we add any multiple of a column (or row) to other column (or row), the former column (or row) should be left as it is. If, on the other hand, the former column (or row) is again added with a constant multiple of the latter column (or row) at the same time, then we shall get such fallacious results. The correct way of using the theorems stated above is as follows :

$$\Delta = \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix} = \begin{vmatrix} a_1 - a_2 & b_1 - b_2 & c_1 - c_2 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}.$$

We can now add with the elements of the second row any constant multiple of the first row or second row and write the sum in the second row and leave the first or second row as it is.

Thus,

$$\Delta = \begin{vmatrix} a_1 - a_2 & b_1 - b_2 & c_1 - c_2 \\ a_2 - a_3 & b_2 - b_3 & c_2 - c_3 \\ a_3 & b_3 & c_3 \end{vmatrix}.$$

We can further write

$$\Delta = \begin{vmatrix} a_1 - a_2 & b_1 - b_2 & c_1 - c_2 \\ a_2 - a_3 & b_2 - b_3 & c_2 - c_3 \\ a_3 + a_2 & b_3 + b_2 & c_3 + c_2 \end{vmatrix}.$$

This determinant can not always be zero.

11. Improper use of Symbols

It has been observed that in addition to improper use of mathematical results and formulas, students very often do mistakes in using some mathematical symbols and teachers also do not bother about these mistakes. As a result, students' concept about these symbols remain vague even when they study advanced mathematics. For example, they don't realise the difference between the symbols $=$ and $\Rightarrow$. While they simplify a mathematical expression, they use $\Rightarrow$ in place of $=$ and when they solve some equations or inequations, they use $=$ in place of $\Rightarrow$. It should be pointed out clearly to the students that we can use the symbol $\Rightarrow$ between two statements and the symbol $=$ between two expressions. An equation or an inequation or an identity (which has two sides) is an example of a statement.

Conclusion

The list of examples which has been mentioned above is only a few out of many fallacious results which may arise due to the wrong use of formulas, results, etc. in Algebra. The main objective of mentioning these fallacious results is to show that mathematics is not a subject of mere memorization, it needs a lot of thinking power and a very serious study. To have superficial knowledge in a particular topic in mathematics is more harmful than to have no knowledge in it. Our present day mathematics syllabus is so heavy and haphazard that it is very difficult even for teachers to have thorough concept in all topics in the present day school mathematics. We can, therefore, realise how dangerous it is for the students to have wrong concept in mathematics from the teachers.

With a view to remove some of the wrong concepts in different topics in mathematics which are now being taught in secondary and higher secondary classes from the minds of the teachers, a series of such papers each for a particular topic in mathematics will appear in the subsequent issues of this Journal. The author will be highly pleased if at least a few teachers are benefited from the perusal of these papers. □

Chemistry Teaching and Formal Thought

A. K. KAUSHAL
Kendriya Vidyalaya
Khetrinagar

WITH THE INTRODUCTION of a new system of education chemistry syllabi at different stages have undergone tremendous changes, the basic reason being the explosion of knowledge in the field of chemistry during the last few decades.

In the new textbooks, the content-matter at various levels is relatively more interconnected and of varying difficulty level. Some of the students fair very nicely in the content chapters, covering facts or information but their performance becomes very poor when the question concerning concept-understanding are asked. Sometimes, even good students are not able to reply to very simple questions which involve thinking or application of some concepts. Perhaps something is wrong with their approach to problem-solving which is an indication of intellectual development.

Rote memorization may partially serve the purpose of examination but intellectual development remains the major cause of concern for the teachers. It is so because intellectual development is one of the basic aims of all education. Teachers are invariably interested in classifying the students (consciously or unconsciously) into good, average and poor students and thus helping them accordingly. Without such classification, a teacher may not be able to justify with all the students with reference to his educational responsibility.

Recently, Piagetian approach in the teaching of chemistry has been popular in the scientifically advanced countries. Unfortunately, Piaget has been little known, less understood and least followed in our country. The author believes that this approach can contribute magnificently towards the intellectual development of the children if teachers are acquainted with this approach. In the following paragraphs, an effort has been made to introduce Piaget briefly.

Professor Jean Piaget (1952) has categorized intellectual development broadly under four stages :

1. Sensory motor	From birth to 2 years of age
2. Pre-operational	From 2 to 7 years of age
3. Concrete operational	From 7 to 12 years of age
4. Formal operational	From 12 to 15 years of age

The age ranges specified are flexible but the sequence of development remains unaltered in every child.

Piaget has theorised that environment and intellect interact with one another. It is probably the environment that provides stimulus to the child and, by way of interaction of the intellect to this stimulus, responses are produced. To produce the desired responses, the stimulus say, the environment need to be organized. Further, Piaget has stressed the need of proper developmental sequence keeping in mind the mode and capacity of the thinker and environmental factors. From what has been said above it can be extracted that if right responses produced are adequately reinforced, proper learning can take place.

During the process of intellectual development child applies his previous understanding (assimilation) to what is not understood. He moves from known to unknown and thus experiences accommodation. For this adjustment he may need the help of the teacher but at all costs the balance between assimilation and accommodation must be restored each time. Here, it may be carefully noted that the child is not moving in cyclic process but is moving up the

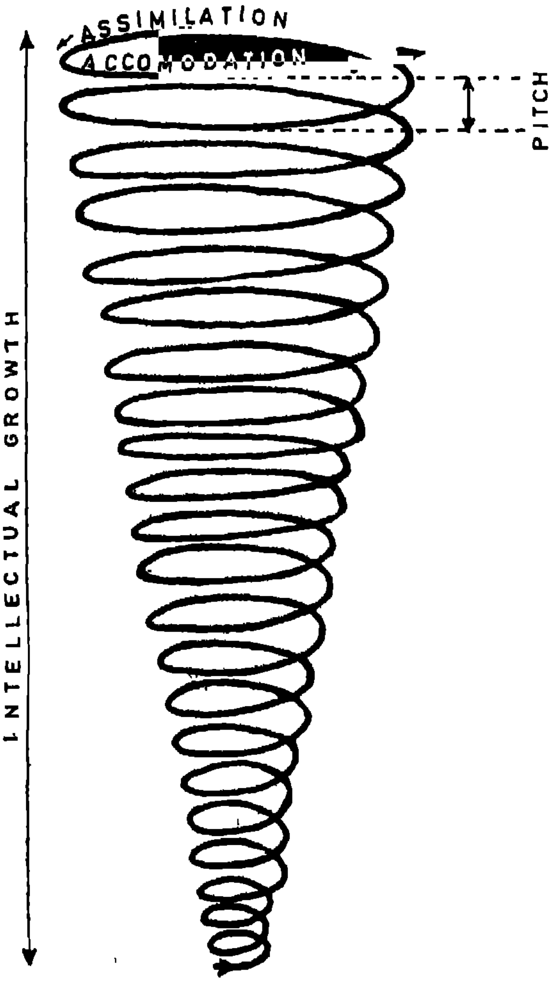

Fig. 1

spiral. The magnitude of the pitch of the spiral may be, however, small (Fig. 1).

Concrete and Formal Operational Thought

It is an old assumption that when students accommodate facts, figures and information, intellectual development takes place which gives him the ability to think abstractly. But, if it were so, there would be no need of formal teaching.

At the Piagetian pre-operational stage child starts interacting with the environment and tries to make conclusions but is not able to do so efficiently. A concrete thinker is, however, a step higher. His mental operation utilizes information he has received from concrete experimentation, exploration or some real happening. He can further interact with this information mentally and thus invent concepts or draw his own conclusions efficiently. Mental operations so carried depend upon students' interaction with concreteness. This type of thinker is in fact a concrete operational and the thought so developed is concrete operational thought.

The next higher stage involves abstract thought which utilizes the use of propositions, theories, derivations, etc. So, instead of concrete realities he has utilized theories to develop his own ideologies, beliefs and concepts. He is said to have developed formal operational thought. In Renner's (1976) sense he performs mental operations in a hypothetically deductive manner. In order to move from concrete to formal thought, concrete operational students must think.

The difference in the quality of thought begins to appear at about 12 years of age and is clearly visible in some students at about 20 years of age. Kohlberg and Gilligan (1971) have found evidence of widespread concrete thought in persons from 10 to 50 years of age. McKinnon and Renner (1971) have shown that 50 per cent of Oklahoma's entering college freshmen and 66 per cent of its high school seniors still occupy the concrete operational stage in intellectual development. Dudley Herron (1975) concluded from the available data that 50 per cent of college entering students in courses for non-major were unable to function at an intellectual level which is formal operational in Piagetian sense. Kaushal (1977) conducted similar studies in Kendriya Vidyalaya, Khetri Copper Complex, with the students who have opted major chemistry course and from the studies it is concluded that 70 per cent of the students were operating at the concrete level.

Studies Conducted at Kendriya Vidyalaya, Khetrinagar

A test comprising of the short-answer type questions and a practical was administered to the 16 students who qualified to opt chemistry major course at the +2 stage. The text of the questions is given in appendix'A'. Through these questions, the author has tried to test the basic characteristics of the formal thought namely the hypothetico-deductive logic and proportional reasoning. Results of achievements of this test are supposed to be substantially related to a student's level of intellectual development as measured by a battery of Piaget's tasks and allied tests conducted by Lawson (1977), Raven (1973), Renner (1977), Sills (1977) and Blake (1976).

Chemistry and Formal Thought

As chemistry is an experimental science, it should provide sufficient opportunities for students to promote their intellectual development through extensive experimentation. Piaget (1964) has stated that to move from one intellectual level to another, e.g. from the concrete to the formal stage experience is one of four factors which must be present. McKinnon and Renner (1971) confirmed that well thought out experiences do encourage students to move from concrete to formal thought. Piaget (1973) stated "An experiment not carried out by the individual himself with all freedom of initiative is by definition not an experiment but mere drill with no educational value". The foregoing researches prove that a well thought out planning of content and classroom teaching incorporating graded experimentation can promote intellectual growth.

Chemistry is one of the richest branches of science which can provide the students with the experience to interact with environment. During experimentation, students can be exposed to many experiences such as setting up of apparatus, keen observation of reactions, skilful detection of ions, extensive understanding of the nature of chemicals, usefulness of some chemicals, alternative use of similar chemicals, precise interpretations, developing thought provoking hypothesis and making bold predictions, etc. Predictions made by Mandelleeff astounds one even today because of the magnitude of insight which he developed by extensively interacting with the nature of the substances. He has truely developed abstract thought which remains unparalleled in the field of chemistry even today.

In the end, the author expresses his thanks to Dr. N. Vaidya, Professor of Education and Dr. J.K. Sood, Reader in Education, Regional College of Education, Ajmer, for their valuable suggestions and guidance. He also expresses his gratitude to Shri K. S. Kulshreshtha, Principal, Kendriya Vidyalaya, Khetrinagar, for continuous encouragement and providing motivation to write this article.

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APPENDIX A

Q. 1. A, b, c and d are four islands in the ocean. People have been travelling among these islands by boat for many years but recently an airline started operating in these islands. Carefully read the following statements about the possible plane trips at present.

The trips between islands may be direct or include stops and plane-changes on an island. When a trip is possible, it can be made in either direction between the islands. People can go by plane between islands c and d. People cannot go by plane between islands a and b. People can go by plane between islands b and d. Can people go by plane between islands a and c ?

Ans. Choose your answer :

A. No, because no statement was made about a plane connection to island a.

B. No, because if you could fly between islands a and c, then you could fly between islands a and b which is not possible.

C. No, because since you can fly between islands b and c, you could fly between islands a and b which is not possible.

D. Not enough information is given to know.

Q. 2. Which of the following species can act as an oxidizing agent in aquous solutions.

O_2 , O , O— and O_3

Ans. Choose your answer :

A....................O_2
B....................O
C....................O—
D....................O_3

Q. 3. How much potassium thiocyanate is needed to prepare 25 ml of its 2.5 M solution. From this solution, prepare 100 ml of 0.25 M potassium thiocyanate solution. Describe full calculations and the procedure. (Mol. mass of KCNS = 97.18)

Q. 4. Applying Le Chatelier's Principle, predict favourable conditions with your arguments for maximum yield in the reaction :

$N_2 + 3H_2 \rightleftharpoons 2NH_3 + \text{Heat}$

Q. 5. Practical : Do as directed below :

You are provided with four numbered bottles filled with colourless solutions (the solutions are dilute sulphuric acid, oxygenated water, pure water and sodium thiosulphate) and another bottle filled with a solution labelled 'X' (potassium iodide). You are then asked to use what is in the numbered bottles to produce a yellow colour, when 'X' is added. Write in sequence all the attempts you make. ☐

Students Corner

LET'S KEEP STRANGE PETS

SHAKUNTALA BHATTACHARYA
Department of Education
in Science and Mathematics
NCERT, New Delhi

Note: *Before you embark on this project please ask the permission of your parents and seek the guidance of your teacher.*

HAVE YOU EVER been jealous of your friends who have pet dogs or cats? Why not keep some strange creatures yourself and make them jealous some of the common small animals in your neighbourhood—earthworms, cockroaches, spiders and caterpillars. I can hear you say ugh! But, once you keep them as pets you will find them more interesting than dogs or cats.

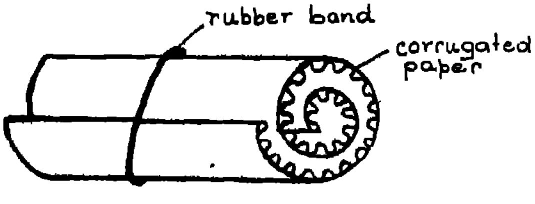

Fig. 1 Corrugated paper roll for Cockroach Housing

Let us start with cockroaches. They are to be easily found in dark damp corners of most kitchens. To trap them, lure them into small boxes or jars with scraps of food and then close the lid. For housing them you will need a large jar (1.5 Litre or more in volume)—a 200g coffee jar will suffice. Clean it thoroughly. Put in a loose roll of corrugated paper, such as used for packing (Fig. 1). Place two to three adult cockroaches into the jar. Close the top with fine wire netting to allow for aeration. If you cannot get wire netting make fine holes in the plastic lid. If you cannot procure a jar, a shoe box then a wooden box with a fitting glass lid should suffice. However, assure aeration by small holes in the wood or cardboard walls.

Feed the cockroaches on scraps of left-over food. Find out their likes and dislikes. Do they prefer moist food or dry food? What are their mouth parts like? What do they use feelers for? Do they feed during the day or night? Do they move about in the day time? Where do they lay their eggs? If you can get hold of a cockroach carrying an egg case, separate it out into another similar housing. Observe where it lays the egg, you can almost time the different stages—number of days to hatch, the in-between stages and time to reach maturity. And if you have bred too many of them why not try and design an experiment to find out which insecticide is most effective against them, and at what stage. (Caution: ask your teacher about the precautions to be taken while handling pesticides).

Another interesting pet is the earthworm. To build a wormery you can either use a tall glass jar, or one similar to that shown in the Fig. 2. Put in layers of soil, chalk and sand as indicated. The soil should be collected from the same place as you collect the earthworm. Earthworms are best collected on a damp evening or before sunrise. Locate a place where you can see worm casts. At night walk softly into this area and shine a torch you will see worms. Catch them quickly or they will slip into their burrows and put them into a jar. Don't forget to collect enough soil from the area for your wormery. During the day time, worms can be removed from waste ground by watering the plot with a dilute solution of formalin (25 ml of 40 per cent formalin to a gallon of water). Collect the worms that appear, and wash them immediately. Pour some plain water on the area and you should get some more worms. Don't forget to wash them too!

Once your wormery is completed, place a few earthworms in it and cover with wire gauze. Watch them burrowing in. How do they burrow? Place a few leaves, stones and pieces of meat on the surface. What do they prefer for food? What happens to the leaves? Put leaves from different plants on the top of the soil and see which ones the worms prefer. How and where do the worms feed? Cover the glass sides with dark paper and after a few days, remove them for a short period. Observe the burrows with worms in them. If the glass panes are not covered can you see the burrows. What happened to the chalk and sand layers? And how long did it take? Do the worms stay near the surface or burrow deeply? Incidently, water the wormery lightly once in a while to keep the soil moist. What happens when there is flooding or drying during rainy and hot seasons?

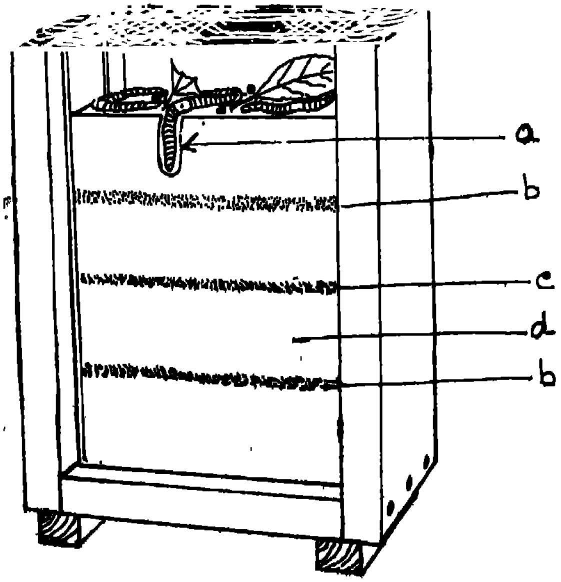

Fig. 2 a. Soil, b. Chalk Powder, c. Sand

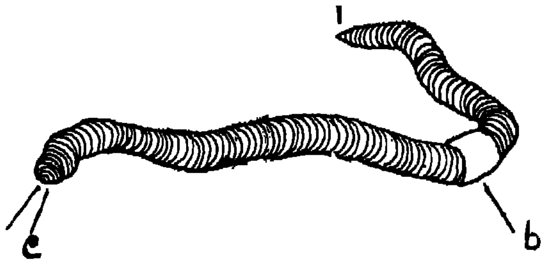

Fig. 3 a. Mouth, b. Saddle c. Anus

Why not take out a worm, and observe its parts with a hand lens. Can you locate the various parts shown in the Fig. 3. Do worms have legs? How do they move? Do they prefer moist or dry areas? Take a piece of blotting paper and wet half of it. Place the worm in the centre, which way does it move. Do they like light or dark? To find this out take a 30 cm long and 3—4cm wide glass tube and wrap one end with black paper. Place the worm in the middle. Shine a torch on the other end and record the reaction. Cover the tail portion with black paper and shine light on the head and vice versa. What happens? Shine the light on the saddle. What happens now?

If you can maintain your wormery for a long time you might even get some baby worms and watch the grow up.

If you have been successful in experimenting with cockroaches and earthworms why not write and tell us about your experiences, so that we can pass it on to others.

How Good are You in Science ?

How good are you in Science is being introduced as a regular feature from this issue. You can use it for a fun or prepare yourself for a test. Score the answers and check up with the given key.

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1. What is the name given to the arrangement which consists of tiny droplets of fat suspended in a liquid :
   (a) An emulsion
   (b) A solution
   (c) A saturated solution
   (d) A colloid
   (e) A fatty acid
2. Two powders have become mixed by mistake. They can be separated if :
   (a) they dissolve in water
   (b) a liquid can be found which will dissolve both equally well
   (c) a liquid can be found which will dissolve one but not the other
   (d) if they dissolve in a mixture of two liquids
   (e) they have different boiling points
3. The temperature of your body is about :
   (a) 27 °C
   (b) 37 °C
   (c) 47 °C
   (d) 98 °C
   (e) none of these
4. A thermometer measures :
   (a) heat
   (b) therms
   (c) temperature
   (d) calories
   (e) weather
5. The male cells of a plant are contained in:
   (a) ovary
   (b) petals
   (c) sepals
   (d) gynaecium
   (e) stamen
6. Which one is an insulator ?
   (a) knife blade
   (b) rubber gloves
   (c) copper pot
   (d) safety pin
   (e) stainless steel spoon
7. Two non-reacting gases have a tendency to mix with each other. This phenomenon is known as :
   (a) diffusion
   (b) effusion
   (c) chemical reaction
   (d) condensation
   (e) explosion
8. When iron rusts it combines with oxygen of air to form iron oxide F_2O_3. Which of the following statements is false :
   (a) The mass of the reactants equals the mass of the product
   (b) Oxygen gas is triatomic
   (c) Atoms are conserved
   (d) Fe_2O_3 is red in colour
9. Which of the following statements is true about the allotropes of an element ?
   (a) They exist in the same physical state but have different chemical properties
   (b) They exist in the same physical state but have different physical properties
   (c) Their physical properties are independent of their physical properties
   (d) They have different physical states but same chemical properties.

10. When a plant shows movement in response to touch it is known as :
(a) hydrotropism
(b) geotropism
(c) thigmotropism
(d) heliotropism
(e) chemotropism

11. Red blood cells are produced in :
(a) liver
(b) kidney
(c) lymph nodes
(d) bone marrow
(e) plasma

12. Breakdown of which foodstuff gives nitrogen :
(a) sugar
(b) protein
(c) fat
(d) carbohydrate
(e) starch

13. Which of these organs do not form a part of the excretory system in man :
(a) kidney
(b) bowman's capsule
(c) bladder
(d) stomach
(e) ureter

14. Which of these scientists was concerned with the development of the Cell Theory :
(a) Linnaeus
(b) Darwin
(c) Galileo
(d) Schleiden
(e) Liebig

15. To which family does the potato plant belong ?
(a) Rosaceae
(b) Liliaceae
(c) Solanaceae
(d) Graminae

16 Which of these animals is a vertebrate :
(a) starfish
(b) silverfish
(c) catfish
(d) crayfish

17. Which of these animals are an endangered species :
(a) spotted deer
(b) rhinoceros
(c) monkey
(d) field rat

18. Which one of the following contains iron :
(a) chlorophyll
(b) haemoglobin
(c) vit B 12
(d) ascorbic acid
(e) folic acid

19. Which of these chemicals is used as fertilizer :
(a) ammonuim molybdate
(b) potassuim silicate
(c) urea
(d) iron oxide

20. To remove grease stain from a shirt you will use :
(a) tap water
(b) distilled water
(c) carbon tetrachloride
(d) calcium carbonate

21. In which of the following meduim the speed of the sound is least :
(a) rubber
(b) water
(c) air
(d) steel

22. In a movable pulley the effort is :
(a) negligible
(b) half of the load
(c) equal to the load
(d) twice the load

23. When force is measured in Newton and distance in metre then the work is measured in :
(a) Kg Wt
(b) Watt
(c) Joule
(d) Kg Wt m

24. The tyres of a scooter mostly slip when it is driven over a sandy road because the surface :
   (a) decreases the inertia of the scooter
   (b) increases the inertia of the scooter
   (c) increases the friction between road any tyres
   (d) decreases the friction between road and tyres

25. A beam balance is used for comparing the :
   (a) density of two bodies
   (b) weight of two bodies
   (c) volume of two bodies
   (d) mass of two bodies

26. When a fuel burns which of the following energy transformations takes place :
   (a) electrical to mechanical
   (b) chemical to thermal
   (c) kinetic to thermal
   (d) mechanical to thermal

27. In an echo we hear :
   (a) only original sound
   (b) only reflected sound
   (c) original and reflected sounds simultaneously
   (d) original and then reflected sound

28. The potential energy of a body depends on its :
   (a) height and weight
   (b) height and mass
   (c) height and speed
   (d) speed and mass

29. The space above the mercury in a barometric tube is :
   (a) dry air only
   (b) vacuum
   (c) water vapour only
   (d) dry air and water

30. Under normal conditions a peeled banana is :
   (a) brittle
   (b) elastic
   (c) plastic
   (d) fluid.

Answers :

1—(a), 2-(c), 3-(b), 4-(e), 5-(e), 6-(b), 7-(b), 8-(b) 9-(d), 10-(c), 11-(d), 12-(b), 13-(d), 14-(d), 15-(c), 16-(c) 17-(b), 18-(b), 19-(c), 20-(c), 20-(c), 21-(a), 22-(b), 23-(c), 24-(d), 25-(d), 26-(b), 27-(d), 28-(a), 29-(b), 30-(c).

Science News

Galaxies Sucking in the Milkyway

Space scientists believe they have found a huge group of star galaxies which are sucking in the Milkyway. The National Aeronautics and Space Administration said, the cluster of hundreds of millions of stars, situated beyond the constellation Virgo was drawing in the Milkyway and earth at a speed of more than 1.6 million kph. Existence of the "super-cluster" became known from data obtained by high-flying NASA U-2 aircraft, the agency said.

Astronomers said, it seemed to stretch over two billion light years of space and contained 30 per cent to 40 per cent more galaxies than normally found in such a vast volume. Dr. George Smoot, astronomer of University of California, said of the discovery :"It boggles the mind that such a structure could exist—a big fraction of the observable universe".

The super-cluster was detected through measurements of cosmic microwave radiation made by the U-2 plane, better known for its electronic spy-flights over earth. Radiation was being measured to test the "bang" theory of a primordial explosion 10 billion years ago, which many scientists believe began the universe.

Dr. Smoot said one U-2 was sent last year to survey remnants of cosmic radiation over the northern hemisphere.

He said the work of two British astronomers, Dr. A. C. Fablan of Cambridge University and Dr. R. S. Warwick of the University of Leicester, had raised suspicions, there was "something unusual" in that area. Other astronomers had got automated counts of faint galaxies on long-exposure photographic plates in the same part of the sky.

The discovery of a super-cluster of galaxies tended to disprove the "big bang" theory of a tightly-controlled explosion with matter moving outward in all directions at an even rate. Instead, discovery of the super stars tended to show that any primordial explosion took place in an uneven way.

Clues to Origin of Life

Dr. Ponnemperuma who heads the Laboratory of Chemical Evolution in the USA disclosed that Japanese scientists have found 200 more meteorites in the region. Already, 1,300 meteorites have been discovered by them and Americans. The deep-freeze conditions there have preserved the meteorites from space in their pristine state.

Meteorites found in Antarctic have revealed vital clues to the origin of life in the universe according to Dr. Cyril Ponnemperuma, a leading geochemist, now on a brief visit to India. An analysis of these "gifts from the heaven" has shown the presence of aminoacids, the building blocks of life but of extra terrestrial origin. They are pre-biotic and not from fossil rocks.

Amino-acids found on the earth, when dissolved in water turn a polarized light leftward. On the earth, life has chosen to be 'lefthanded', whereas in the meteorites examined, the amino-acids exhibit both lefthanded and righthanded features. In other words, the meteorite amino-acids are not among the 20 common amino-acids which make up the protein of living organisms on the earth, he said.

The Antarctic finding comes in the wake of another exciting discovery in the Arctic region in Greenland. An analysis made by Dr. Ponnemperuma and his colleagues of the oldest rocks found there has shown the presence of hydrocarbons formed by living organisms. The samples of the rocks have been dated at 3.8 billion years, which is some 400 million years older than the earliest rocks found till then. The finding shows that life is as old as the oldest rocks on the earth.

The age of the earth has been estimated at 4.6 billion years. The conditions for life to emerge were almost there when the earth was formed. The finding in the laboratory narrows down further the time taken for life forms to appear on the earth. Given the right conditions, life could be instantaneous.

This summer more expeditions to Greenland have been planned and the scientists hope to find still older rocks for analysis on this subject.

Dr. Ponnemperuma, who is associated with biological experiments of space mission, said scientists are eagerly awaiting data on Titan, a satellite of Saturn, from the Voyage spacecraft which would fly past it next year. Titan is the only satellite in the solar system having an atmosphere. However, any water there would be frozen The chances of life there without water appear slim.

Regarding Jupiter the geochemist said its colours were reproduced in the laboratory to show that they were the result of interaction between the various organic molecules in the Jovian atmosphere. But there again, the circulation of the atmosphere and its extreme temperature variations rule out life.

Though there may not be life elsewhere in the solar system, he pointed out that the chemistry related to life is common place in interstellar space. As many as 40 different molecules have been revealed by radiowaves emanating from space, organic chemistry is indeed cosmochemistry, he added.

First Step for Vaccines Against Viruses

A six-man team, reporting on its work in the journal '*Nature*' says it has been able to grow a strain of bacterium with a vital gene inserted in its genetic structure.

This is much easier than culturing the virus on its own and has been made possible by success in isolating the viral gene responsible for triggering the immune response in a person when an infection develops.

The first tests have been with a chicken flu virus but these have indicated that the technique could be used equally well with human viruses.

British scientists at the Searle Research Laboratories believe they have completed the first step towards a new and easier method of producing effective vaccines against viruses such as influenza.

The team says its research has enabled the structure of the virus and that of the protein it produces to be identified for the first time.

It is this protein which triggers the immune response to produce antibodies which enable the human body to combat influenza.

7,000 Year Old Cottonseeds Discovered

A group of French archaeologists, led by Mr. M. Jarriage of Museguiment of Paris, have discovered cottonseeds, believed to be over 7,000 years old from an archaeological site near Sibi town of Pakistan's Baluchistan province.

The cottonseeds might be the oldest one discovered so far. The site has also yielded some prehistoric figurines.

According to Dr. Mahammed Ishtiak Khan, Director of Pakistan Archaeology Department, the site at Mehergarh, 100 miles south of Quetta was being explored and excavated by the French team since 1976.

4,000 B. C. Bangles and Beads Found

A unique hoard of copper bangles, beads and several new seals dating to 4000 B. C. have been found in the course of clearance operations and repairs undertaken by the Archaeological Survey of India at Lothal, the famous port city during the Indus Valley Civilization, in Gujarat, according to Mr. S. R. Rao, the excavator who is trying to save the dockyard and acropolis from further damage.

Mr. Rao said Lothal city was larger than excavations in the sixties revealed it to be. Repairmen found a 50 foot long wall of burnt bricks believed to have been built around 2000 B. C. after the nullah in the northern sector of the city was silted up due to floods.

Mr. Rao said this will not only save some houses from floods but also extend the northern limit of the town. Lothal witnessed four disastrous floods after 2000 B. C. and was finally abandoned.

Referring to the 21 copper bangles and gold and a steatite beads found in the 4,000 year old bead factory at Lothal, Mr. Rao said "even Mohenjo Daro has not yielded so many copper bangles in one lot." An analysis of the Lothal finds shows the use of a small percentage of tin with copper. It appears that copper was available in adequate quantities in 2000 B.C. The circular gold beads found with the "copper hoard" resembled those from the royal cemetery in south Mesopotamia (Iraq).

The beads are of Sumerian origin and throw further light on the brisk trade between Lothal and Sumer through the Bahrain islands during the Indus Valley Civilization.

Five seals two of which are of copper and two sealings, including clay labels used for sealing cargo exported from Lothal have also been recovered recently, thus bringing the total number of seals and sealings to 217. Another important find is a teracota model of a ship which is larger than the one found earlier. It has provision for fixing the sail also, Mr. Rao added.

Solar Still to make Cheap Power Alcohol

An Australian scientist has developed a solar still which could cut the cost of producing power alcohol on farms.

The still, developed by Dr. Dick McCann, Director of the Appropriate Technology and Community Environment Centre near Sydney, is used in conjunction with a small-scale ethanol fermentation plant and can distil a 96 per cent alcohol solution.

Dr. McCann said that normally fuel oil or coal was used for distillation but with increasing fuel costs, this could be uneconomic. The use of the solar still eliminated fuel costs.

The still consists of a flat plate collector on top of a fractional distillation plant containing 60 compartments.

Making the 'He' Plant 'She'

A male-to-female sex reversal is brought about by application of growth regulators such as "gibberellic acid".

Seeds which can yield only female plants can be produced with this chemical technique, Dr. H. Y. Mohan Ram, Professor of Botany, Delhi University said in his presidential address to the botany section of the Indian Science Congress.

Since fruit and seeds are produced by female plants the technique for raising 'female plants only' offers a way for raising productivity of certain crops, he said. "Our work with Cannabis sativa has shown that using this technique seeds which can yield 100 per cent female plants can be produced." Initial success had been attained in his laboratory in inducing castor seeds to bear female plants. "It should be possible to extend this work to plantation crops like nutmeg, date palms and mulberry in which it is profitable to have more female individuals."

According to him, the sex of flowers can be altered by application of growth hormones on the plants at the right time before the natural development of sexual parts in flowers. This has been shown in the case of papaya and cucumber which were induced to bear female flowers following application of hormones like ethrel and abscisic acid.

Awards for Inventions

The National Research Development Corporation of India has announced Republic Day awards totalling Rs. 27,000 for seven inventions besides Rs. 15,000 in financial assistance for the development of two promising inventions.

The Corporation has also honoured 16 student-inventors selected from all over India who will receive cash prizes totalling Rs. 7,700. It has also announced 65 awards totalling Rs. 10,200 to students selected at the State level.

The award winners for the 7 inventions are :

Dr. T. C Boruah of Tocklai Experimental Station, Jorhat, for developing a special machine to twist tea leaves in one stroke (Rs. 10,000).

Mr. C. Narayana Rao of Andhra Scientific Company, Hyderabad, for developing a machine for making parabolic reflectors (Rs. 5,000).

Mr. V. L. Sastry, Mr. A. S Ramamurthy, Mr. H. S. S. Prasad and 18 other associates from the Electronic Research and Development Establishment, Bangalore, for developing a "sound range system" with radio link and computer facility which helps to locate guns in a battlefield (Rs. 5,000).

Mr. N. M. Raju and 7 associates from the Central Mining Research Station, Dhanbad, for developing a simple rope stitching technique useful for making roof support in coal mines (Rs. 4,000).

Mr. M. C. Guru and Mr. Abdul Rashid of Central Coalfields Ltd., Hazaribagh, for developing a machine to cut spiral bevel gears using formate cutting for pinion and gear (Rs. 2,000).

Mr. S. M. Agrawal, Mr. S. C Saraswat and Mr V. Venkataraman of Instrumentation Ltd., Kota, for developing a pneumodigital indicator in which a pneumatic process signal is converted into electrical signal and the same is electronically displayed in digital form (Rs. 1,500).

Mr. G. Aggarwal and Mr. B. S. Badhoria of the College of Agriculture, Himachal Pradesh University, Palampur, have been given certificate of merit for developing an inexpensive device to record seedling emergence force.

Financial Aid

Financial assistance has been sanctioned for the following inventions :

Dr. D. Mukhopadhyaya of Steel Authority of India Ltd., to develop a bone stapler and staple carrier which would replace five instruments used at present in bone surgery (Rs. 9,000).

Mr K. S. Ayyar of Mysore, to improve the performance of the table fan by incorporating modification to the air circulating system (Rs. 6,000).

Tushar Kumar Mukhopadhyay, a student of agricultural engineering at the Indian Institute of Technology, Kharagpur, has been named winner of the invention talent contest held by the corporation with the first prize of Rs. 1,000.

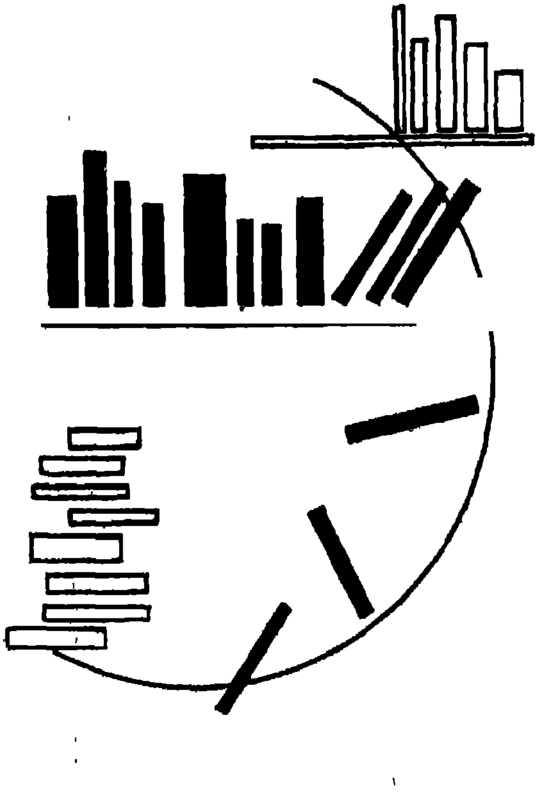
Subhas Majumdar of Maharaja Bir Bikram College in Agartala and Rizwan Akhtar Siddiqui of the St. Mary's High School in Delhi won the first prize in the invention contest.

Nishikant Sonwalkar of Govindram Saksaria Institute of Science, Indore, won the second prize in the invention contest.

The third prizes (Rs. 600) were awarded to B. K. Ramesh of GBDT College of Engineering, Davanagere, and Abhut Sharatchandra Tase of Parle College, Bombay.

The students named in awards also include Anil Kumar Jain of Ajmer Polytechnic (Rs. 500), S. Balagurunathan of A. V. C. College at Mannampandal, Tamil Nadu (Rs. 400), Indra Kumar of Banaras Hindu University (Rs. 400), C. S. Pratap Sunder of S. V. V. College of Engineering, Tirupati (Rs. 400), A. V. Lakshmi of St. Joseph's Convent Secondary School of Bhatinda (Rs. 350), Subrata Sen Sharma of Multipurpose H. S. Institution, Calcutta (Rs. 350), Upendra Nath Madan of Government College of Meghalaya at Tura (Rs. 250), Dharmendra Joshi of R. M. Vidyalaya, Nanswada (Rs. 250), and Bhaskar Bandopadhyaya of B. H. S. School, Agartala (Rs. 250).

Book Review



Diagnostic Testing in Advanced Chemistry

A. Brookes and W. A. H. Scott, Hodder and Stoughton, London, Sydney, Auckland, Toronto, pp. 177, £ 3.25.

THE expansion of scientific knowledge and consequently the change in the system of education has led to a modification in the method of instructions and also the system of evaluation. Today the stress is laid on inquiry approach and discussion method of teaching instead of the age-old lecture method. Similarly the present system of evaluation involves the use of various types of objective and short answer types of test items having fixed response. The test items based on perfect educational taxonomy can be used: (a) to initiate an inquiring tendency among pupils leading to an active class discussion, (b) day-to-day evaluation, and (c) for diagnostic and remedial purposes.

The authors of the present book have made an attempt to present the test items in chemistry keeping in view the above objectives. The book contains twenty-three chapters in all. The selection and sequencing of chapters is good and call the pupil's attention to the main aspects of fundamental chemistry which helps to create interest in the subject and thus facilitates its learning. The test items given in each chapter, about ninteen to twenty-five in number, are based on three educational objectives i. e. knowledge, comprehension and application. The technique of constructing the items is such that the answer of each question involves a definite previous knowledge without which it is not possible to answer the item. This makes the assessment of knowledge of a wide subject area only through a few test items. The units used in the book for physicochemical quantities are in SI units or other units accepted for general use. The nomenclature of compounds used is that recommended in the ASE publication of 1972, chemical nomenclature, symbols and terminology. In case of inorganic compounds, the common names have also been mentioned at few places in order to avoid the confusion. The answers, the intellectual skills likely to be involved in answering the items and the diagnostic notes given in the later section of the book form its important feature. The diagnostic notes give details of the previous knowledge required in answering the test items.

Although the book contains test items based on various mental skills, but the authors have restricted mainly to multiple choice type of items. The inclusion of short answer and other objective types of items like matching type, fill in the blanks etc. will increase the utility of the book in general. The number of test items given in some chapters are less considering bulk of the subject covered. In the first chapter on atomic structure, the emphasis has been laid on radioactivity while the other important topics like Bohr and sommerfield theories, quantum numbers etc. have been left out. Similarly in chapters XVI to XIX, the stress has been given by incorporating the items on nomenclature and properties of organic compounds. The items on preparations of various compounds also need a place in these chapters.

The chapter XV on fundamental organic chemistry covers a wide area of basic organic chemistry. The topics, isomerism and effect of structure on reactivity, given in this chapter, should be dealt with as separate chapters with more number of items so as to facilitate gradual development of the subject.

On the whole the book provides a good number of multiple choice type model test items based on modern technique of evaluation and is intended to help the teachers in constructing the items themselves for testing the achievement of their pupils at higher secondary level.

B. PARKASH
Lecturer
Department of Education in Science
and Mathematics, NCERT, New Delhi

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Smoking—A Man-Made Dragon

NEDD WILLARD

Lung cancer, gastro-duodenal ulcer, circulatory disorders and heart attacks, risks to the unborn child; All these may stem from a single culprit the factory-made cigarette.

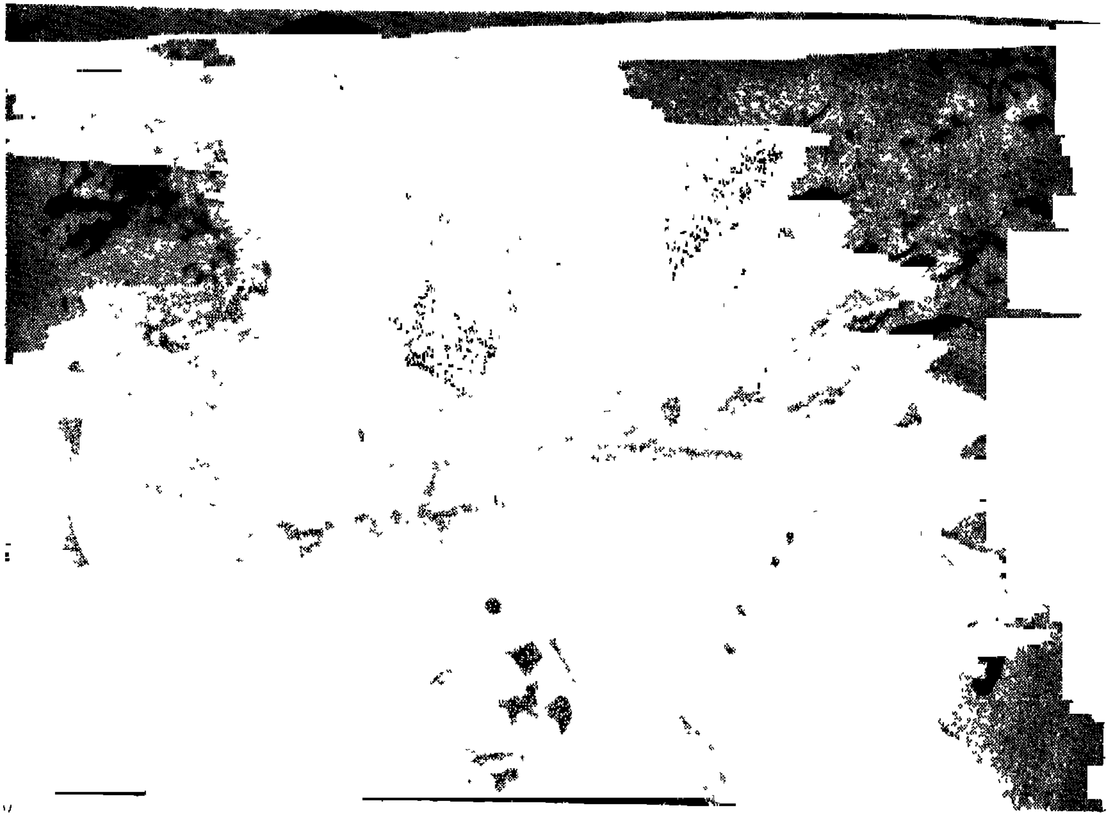
IN CHOOSING the slogan "Smoking or Health—The Choice is Yours" as the theme for next year's World Health Day, WHO has pledged itself to tackle the modern-day dragon of smoking in earnest. The challenge of this man-made plague is a bold one since it involves everything from teenage behaviour and pharmacology to tax revenue and crop substitution.

Smoking cigarettes is a social and a personal habit. It is a way of making friends and killing time. It is also a high-powered transnational industry employing the most modern forms of production and persuasion. With sales outlets that can reach almost any spot on the globe where someone would like to buy a smoke. In all the world there is probably no form of distribution so efficient for any other product or service. A small thatched hut, located where two camel paths converge in the desert, sells cigarettes; at a ferry stop by a jungle river there is a battered tin advertisement for the cigarettes that can be bought right there; in slums and in elegant nightclubs, in cartons, smuggled or legally declared, in packs or singly, cigarettes can be had anywhere on the face of the earth. Unfortunately, it is a proven fact that the use of cigarettes is closely linked to ill-health, crippling disease and premature death.

Around the year 1610, King James I of England delivered a blast against the custom that explorer Sir Walter Raleigh had recently introduced from the New World—a custom which he called "loathsome to the eye, hateful to the nose, harmful to the brain, and dangerous to the lungs". His censorious remarks were perhaps over-moralistic and delivered in a tone that today makes non-smokers seem aggressively priggish rather than just people who prefer to inhale their air fresh, clean and unpolluted. Medically, on the other hand, His Majesty was not too far out.

Tobacco will grow almost anywhere in the world except in extremely cold regions. About 120 countries today are engaged in growing tobacco for their own use and for export. But tobacco production is rising most rapidly in developing countries. This is because domestic sales have grown quickly, and government policy is, often short-sightedly, to offer full backing. Growing tobacco for cigarettes looks like an easy way to reduce imports, to increase earnings in foreign exchange and to provide employment. But if this trend continues, it will prove to be a dangerous introduction of a man-made epidemic.

Over the years, there have been constant changes in the ways of taking tobacco—whether as hand-rolled cigars inserted into the nostril, in pipes, as snuff or as raw "plugs" for chewing, until the most convenient and dangerous way of all was devised: factory-made cigarettes.



Where food is scarce and malnutrition rife, it is surely criminal to devote food agricultural land to growing tobacco

that allow continuous deep inhalation. Introduced after the Crimean War in the 1850s, cigarette smoking spread fast and far. However, the fact that the factory-rolled cigarette came so late may prove to be an advantage to those everywhere who are trying to get humanity to break the habit or not acquire it. Cigarette use is not a deeply rooted cultural tradition going back to earliest times.

The First World War killed a lot of men and introduced a great many of the survivors to the cigarette. Since cigarettes are a good way to pass away the time, and since they are easily habit-forming, they have always proved a popular gift from the authorities to the troops. They also tended to confirm the image of the virile smoker. By 1920, cigarettes in Europe dramatically dominated the sales of tobacco products, and this lead has been maintained. Today in the UK for example, fewer than 5 per cent of men smoke only pipes or cigars.

But as the smoking dragon changed its habits, it changed its social character as well. The use of cigarettes has recently ceased to be largely a male characteristic; since the Second World War, women have taken up the practice in earnest as well.

It is hard to give an exact picture of cigarette smokers around the world today because information is abundant in some places, almost non-existent in others, and the picture itself keeps changing. Generally speaking, people in the developing world consume far fewer cigarettes than do their counterparts in highly industrialized communities.

The United States still leads the world in cigarette consumption, with an average of over 2,700 cigarettes per person each year. Western Europe is close behind with figures that run from 1,000 to 2,000 cigarettes per person. In most European countries more than 50 per cent of the adult males smoke an average of 15 cigarettes a day. Women get through between 10 and 50 a day; moreover, the incidence of women smoking continues to rise while that of men is beginning to show a downward trend. As more women start the habit, so the statistics show them falling victim more frequently to lung cancer and coronary heart disease.

In Belgium, 50 per cent of the young people smoke by the age of 15. In the Federal Republic of Germany, 36 per cent of the 10 to 12-year-olds are already confirmed, regular smokers. In Italy, 60 per cent of boys are cigarette users by the time they are 15. A recent survey in a Latin American City showed that 45 per cent of the men and 18 per cent of the women smoked.

The Dangers are Real

Clearly, the bad news has not yet reached everyone about smoking, not by any means. For that reason it is worth summarizing some of the ill-effects incontrovertibly associated with this habit.

Smoking related diseases are important causes of disability and premature death in developed countries. In these countries, control of the cigarette could do more to improve health and prolong life than any single action in the field of preventive medicine.

Where cigarette use is widespread, cancer mortality is rising steadily. Smoking is associated with 90 per cent of lung cancer cases. Conversely, lung cancer rates are low in countries where cigarettes have only recently taken root, but they will undoubtedly rise in the future. The relationship of smoking to lung cancer was clearly shown in a survey made among British doctors between 1951 and 1971. Today the majority of physicians are non-smokers or have now stopped smoking; as a result, their rates of lung cancer and other smoking-related diseases have dropped notably, by contrast with the population at large whose cigarette consumption has not declined—and neither has its rate of lung cancer.

How many cigarettes a day does your child smoke?
When a child breathes air filled with cigarette smoke
it can be as bad as if he actually smoked the cigarette himself
Don't smoke when there are children present.

Anti-smoking poster emphasizes the message that smoke-filled air is as bad for children as if they smoke cigarettes themselves

In view of their increased liability to lung

cancer and obstructive lung diseases, smokers are especially prone to the adverse effects of air pollution. This presents a special risk for workers in situations where air pollution is high.

The habit is a major risk factor for both fatal and non-fatal myocardial infraction (heart attacks). In young people, ischaemic disease of the lungs, where the blood circulation is blocked, appears to be confined exclusively to those who smoke.

Gastro-duodenal ulcer is about twice as common in smokers as in non-smokers. A New York study found a twofold increase in the relative risk of bladder cancer in male smokers.

Given the variety of disorders that affect tobacco addicts, it is scarcely surprising that they are far more likely to miss days at work than non-smokers. In one Polish study, smokers were shown to be ill 3.5 times more often than non-smokers and had twice as many accidents.

Ill-health is not fair or even-handed; it happens that women and children are exposed to certain special risks from tobacco. The risks begin even before the child is born. Maternal smoking retards foetal growth and increases the risk of death immediately after delivery. Risk of prenatal death increases by nearly one-third in mothers who smoke regularly after the fourth month of pregnancy. Children born of pregnant mothers who smoke tend to be smaller, more liable to birth defects, and more susceptible to disease. Spontaneous abortion rates are statistically related to cigarette consumption among pregnant women.

Women who smoke should not take the contraceptive pill. If they insist on smoking they must find other methods of contraception, since the combination of cigarette use and the pill can lead to serious heart attacks and circulatory disorders such as blood clots. Women who smoke also tend to start the menopause at an earlier age.

An Adult Decision

The champions of the tobacco companies and ill-informed people often say that smoking is an adult decision, one that individuals make for themselves on the basis of their own experience. Yet the average age of beginning to smoke in many countries is nine or ten years. Some children get through their first cigarette when they are only five, and about one in three of those who become regular smokers will start the habit before they are nine. This is hardly an adult process or decision. Children are thus, at special risk and need special protection.

So far we have spoken only about illness, disease and premature death, since these consequences are the most dramatic and the easiest to comprehend. But the cost of medical care for those made ill by smoking, the loss of productivity from tobacco-related illness, and the loss of life and property from fires caused by careless smokers and up to a huge total—one that far exceeds the economic value of the tobacco products. All of society must bear the economic burden for the damage that smoking does.

Ecologists will note that cigarette production helps to cause deserts. In developing countries, where wood is needed to cure the tobacco leaves, every 300 cigarettes made require another tree to be cut down. And where food is scarce and malnutrition rife, it is surely criminal to devote good agricultural land to growing tobacco.

If all these damaging facts are beginning to be known, why are not governments taking prompt action and why has not everyone stopped smoking?

In fact, the cigarette industry is prosperous and growing. The world production of cigarettes was about 3,850 thousand million in 1976. To unwary governments, cigarette production still looks like an easy way to make jobs, to collect taxes and to increase export earnings. Moreover, around the world, advertising continues its siren song—loud, clear, persistent. Advertising for cigarettes in the US alone has gone up from $ 300 million in 1975 to double that figure at present. The sum for all the advertisements around the world must be almost beyond belief.

In developing countries, cigarettes are being actively sold as a means of social promotion; "the man who gets ahead, smokes". And this is further shown by the preference for foreign brands or those that emphasize sophistication in their advertisements—"the elite smokes". Generally speaking, the advertisements in all countries link the habit with social and sexual success: the way to make friends, the way to meet glamorous people, is to smoke. Peer pressure helps reinforce the advertisement, and often cigarettes are seen as a way of flying the flag of rebellion against authority or parents.

One of the main troubles with beginning to smoke, according to the Royal College of Physicians in the UK, is that it gets to be a habit, for almost everyone. "Even the most stable and well-adjusted person will, if he smokes at all, almost inevitably become dependent on the habit".

There is, therefore, an in-built momentum in this practice that will take time to slow down in many countries. There are also vested interests and clever appeals directed to political and economic bodies. Many health professionals, far from giving a wise lead, still use cigarettes themselves, often in the presence of patients and on the premises of institutions supposedly devoted to improving health.

Smoking : Is it worth the risk?

However, the wind is changing, at least in most of the developed countries. No matter how poor the campaign of information, no matter how staunch the resistance of the tobacco industry, wherever anti-smoking programmes have begun, the result has been to stop the rise in consumption, to level it off and then to begin its decline.

The United States presents a striking example of how good results can be achieved by hard work. Until the first Surgeon General's report in 1964, the number of persons smoking had been rising steadily. Americans were consuming more cigarettes than anyone in the world, and paying the price for it in cancers, heart diseases and respiratory disorders. The tide has changed, the public has been alerted and the number of adult men smoking, for example, has dropped from 52 to 39 per cent and is still falling. By 1975, three out of every seven US male smokers had become ex-smokers. Adult women also smoke less and the percentage of smokers among teenage boys has not risen in the past 20 years. On the other hand, the number of young women taking up the habit has somewhat offset the good news and changed the picture; today, as many teenage girls as boys are smoking. In this respect the US is probably showing a trend that will soon manifest in most highly developed countries.

A Still Untapped Market

Another major change has appeared in the last few years; as developed countries smoke less, the developing ones are smoking more. In fact, the Third World represents the last, large untapped market for the cigarette companies.

The developing countries, encouraged to produce by the large corporations who control the world market, supply about 55 per cent of the world's leaf tobacco, but they supply it through foreign-controlled marketing channels, which set prices and profit margins. Moreover, their processed exports are almost nonexistent. These countries have no influence on the design, output and changes in the industry. In the race to produce the latest types of cigarettes in a highly capital-intensive industry, they don't stand much of a chance. Some governments may even actively encourage cigarette consumption, and neither the authorities nor the public are usually aware of the dangers to health that smoking represents. Tobacco is in the long run a losing proposition for the Third World.

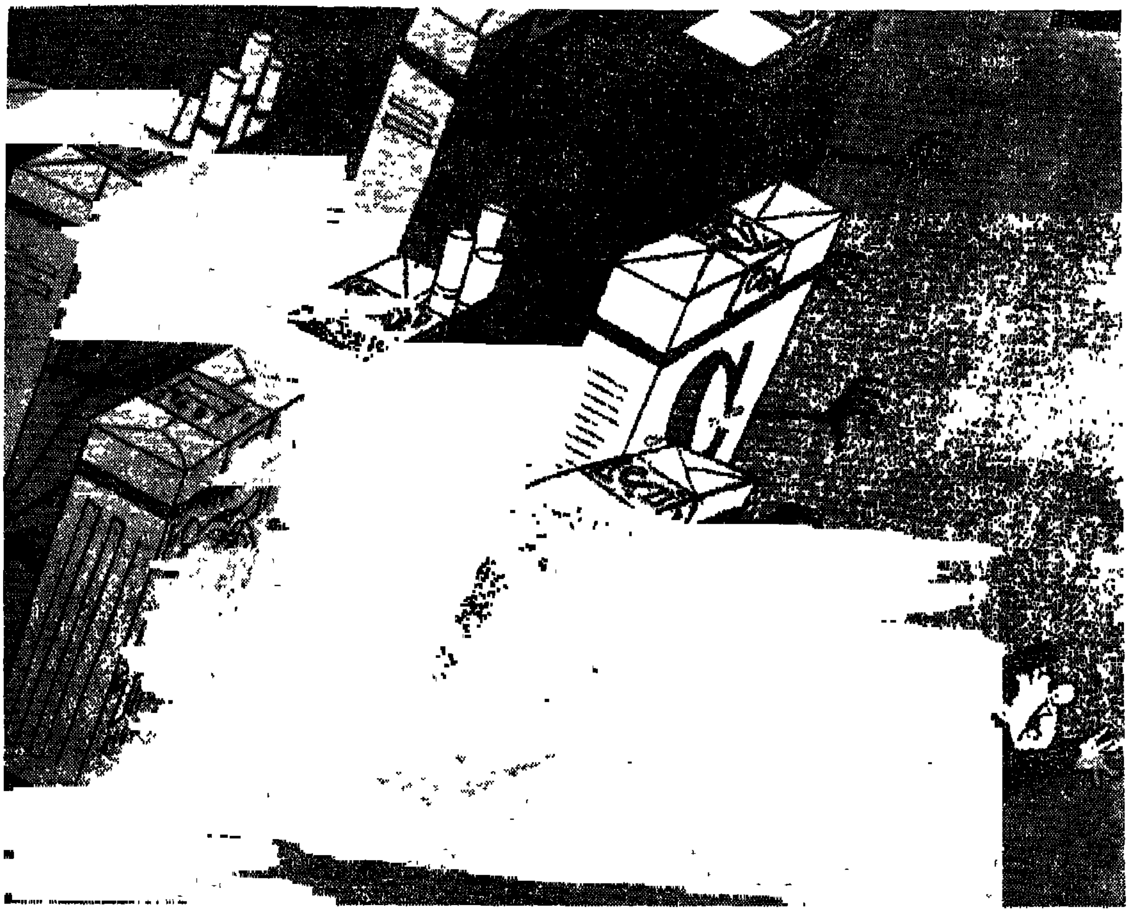
The world community, spurred on by the WHO, has a major responsibility to see that the seeds of tomorrow's epidemic are not planted in developing countries today. Most industrialized countries have already taken steps of some sort to curtail cigarette promotion, but very few Third World countries have even begun. Alerting the public in these countries to the health dangers will prove to be a major task in the next decade for the international community.

The process of mobilizing public opinion is already gathering speed. This month will see the Fourth World Congress on 'Smoking and Health' held in Stockholm, organized by the Swedish Ministry of Health and Social Affairs and by Sweden's National Smoking and Health Association.

The WHO itself will take a leading role in helping countries to learn from each other, and in cooperating with all efforts by governments to rid themselves of this plague or prevent its onset. Other members of the UN family, such as Unicef, FAO and ILO, are being drawn into this important struggle.

Many problems remain to be solved. Techniques for helping "addicts" to stop smoking have a long way to go before they are cost-effective and generally applicable. Pharmacological and physiological questions remain unclear and more work is needed. There are problems of crop substitution, employment, conditions of work and economics to be worked out.

Countries, communities and non-governmental organizations, especially, those connected with heart disease, cancer and respiratory infections, are already trying new techniques and achieving success. Norway placed a total ban on all forms of tobacco advertising in 1975. In Sweden, cigarette packets carry any one of 16 different warning texts. In Austria and the UK, the higher the tar content—the higher the cigarette tax. The mayor of one Black Sea resort in the Soviet Union lets tourists know



Anti-smoking posters emphasize the message that smoking is addictive

that there is no smoking on the beach, in restaurants, offices, public and private transport, schools or hospitals; those who go in search for sun and sea will also benefit from a smoke-free atmosphere.

For WHO, the programme against smoking is crucial since it ties in with the goal of Health for All by the Year 2000, and is an example of primary health care in action. Here is a major question of health where the top-level health professionals such as physicians have only a supporting role to play; the best way to stop lung cancer is not by surgery but by education and prevention.

This health problem is just too big for the medical profession alone to handle. Legislators, labour unions, citizen groups, school teachers, journalists who work in the mass media, all of these have tasks that are just as important. Smoking concerns all of us. It is up to all of us to do something about it.

COURTESY : *World Health*

Interferon : A Potential Cancer Drug

JAGANMAY MITRA
Reader in Zoology, Department of Education in Science and Mathematics, NCERT New Delhi.

DESPITE THE ADVENT of modern medicine, man is still trying, rather desperately, to discover the curative drugs to curb cancer. Unlimited, uncontrolled and repeated division of some cells in the body results in unorganized growth. These cells cut off from the body's growth regulatory and control mechanisms and become cancerous. The cancer cells are not confined to the tissue where they develop but invade other tissues of the body, where they proliferate.

Cancer still remains as one of the major problems of modern biology and medicine. Several physical and chemical agents are being used for the treatment of human malignancies. But, unfortunately, the prevailing treatments with these agents have met with limited success. Cancer researchers round the globe are still making frantic search to discover the curative drugs for different types of human cancer. They have recently become hopeful that interferon might be a potent drug to treat atleast some varieties of human cancer. Although proving interferon's efficacy as a definite cancer drug needs much more rigorous clinical trials, the results obtained so far have made the investigators very much optimistic about its potentialities. In September 1978, the American Cancer Society allocated two million dollars for the purchase of interferon to enable the USA research workers to undertake more critical investigations with this cell-synthesized material.

Discovery and Sources

Twenty-three years ago interferon was discovered by late Alick Isaacs and Jean Lindenmann at the National Institute of Medical Research, London. Its antiviral activity—specially its ability to inhibit viral reproduction had already been proved conclusively. Interferon is considered to be the body's first line of defence against many types of viral attack. Investigations in the recent past indicated that it might have also the potential clinical role in treating some types of cancer in human body. Unlike some other chemical substances used in chemotherapeutic treatment of cancers, interferon is produced in the cells of human and animal body. The sources of interferon, as it stands today, are very much limited. It is produced in cells in a very small quantity. And thus, the paucity of this material hinders wide scale experiments with human patients.

Types and Its Chemical Nature

Atleast, three different forms of interferon have been found till now which are produced from human cells. These are leucocyte interferon, fibroblast interferon and T or immune interferon. Interferons, whether of human or of other origin, are moderately large glycoproteins (protein and carbohydrate) having molecular weights of about 15,000 to 20,000. Most of the interferon preparations so far tested were found to be extremely impure in nature. Of the total protein content of these preparations from different cell types, only about 0.1% is actual interferon. So the investigators are trying and taking all possible measures to purify the impure forms.

Preparation from Leucocytes

Kari Cantell at the Central Public Health Laboratories in Helsinki developed a method of preparing it from leucocytes. Layers of leucocytes are formed at the time of separation of whole blood by centrifugation into plasma, red blood cells and other medically useful materials. The leucocyte-rich middle layers are separated without any significant loss of other blood components. These leucocytes are then purified and induced by Sendai Virus to produce interferon. Until recently all clinical trials with cancer patients had been made with interferon obtained from leucocytes.

Why Cells Produce Interferon?

So far as the production of interferon is concerned, all cells are capable of producing it if they are induced properly. Investigations have shown that usually viral infection and treating cells with double stranded ribonucleic acid (RNA) stimulate them to produce interferon. Besides, many other substances (living as well as non-living) can also induce cells to produce the interferon. These are some bacteria reproducing intracellularly, some parasitic protozoans, the low molecular weight substances like antibiotics cycloheximide and kanamycin

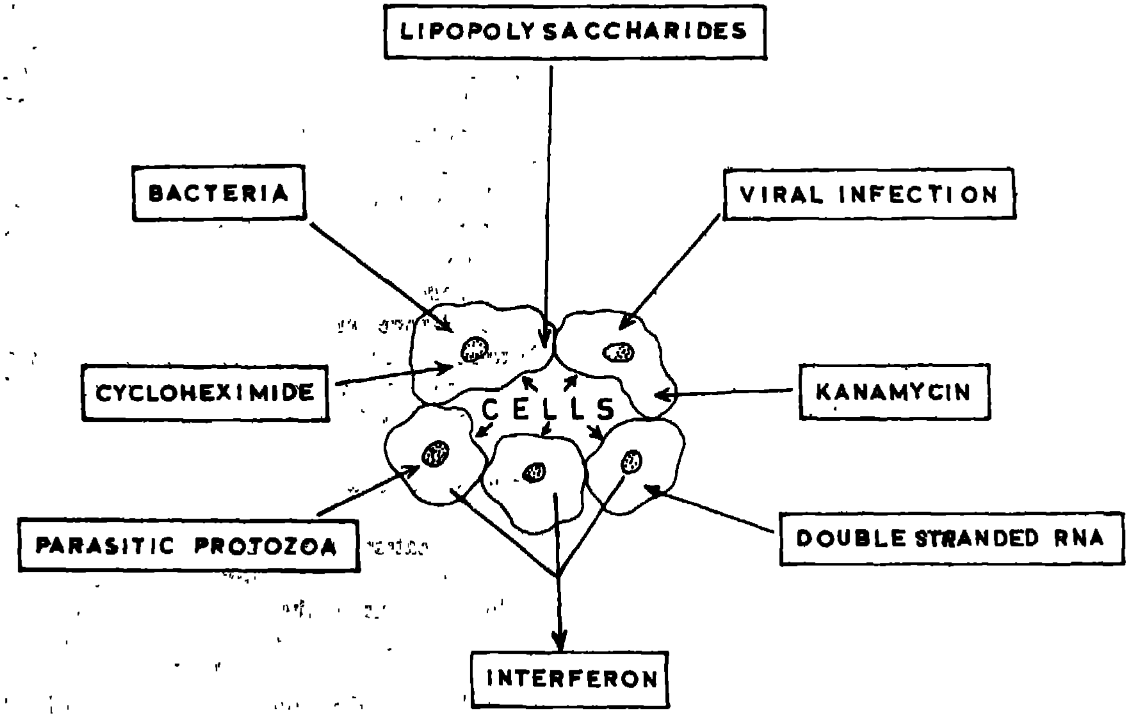


FIG 1. *Agents induce cells to make interferon*

and also the high molecular weight substances like lipopolysaccharides (Fig. 1).

Species-Specificity of Interferon Action

Interferon, whether of human or of other animal origin, is generally species-specific in action. It means, the interferon produced by the human cells acts on human patients suffering from cancer, whereas interferon produced by the cells of an animal is effective on the animals of the same species.

Clinical Trials on Cancer Patients

Since the mid-1960's Ion Gresser and his colleagues at the Institut de Recherches Scientifiques sur le Cancer in Villejuif, France and several other researchers had got evidences that in experimental animals the development of many cancers gets inhibited with the application of interferon. It has recently been reported that human patients suffering from cancers like osteogenic sarcoma (bone cancer), multiple myeloma or Hodgkin's disease (a type of cancer of tissues producing lymphocytes), breast cancer, melanoma (skin cancer) and certain types of leukemia (blood cancers) and lymphoma (cancer of tissues producing WBC called lymphocytes) have responded, to some extent, to interferon treatment.

Hans Strander and his collaborators (1971) at the Karolinska Hospital, Stockholm observed that the patients suffering from bone cancer, when treated with interferon, their survival rate was increased. They also observed that the condition of patients suffering from Hodgkin's disease considerably improved after interferon therapy. However, they tried the drug with a few patients. Interferon therapy was found to be effective by Thomas Merigan of the Stanford University School of Medicine against one type of lymphoma (other than Hodgkin's disease).

Edward Holyoke, Julius Horoszewicz and William Carter of the Roswell Park Memorial Institute in Buffalo, USA, got the evidence that interferon treatment can bring regression of a highly malignant type of skin cancer in human patient. This group of researchers is now using fibroblast interferon in the clinical study instead of leucocyte interferon. Norwood Hill at the Wadley Institute of Molecular Medicine in Dallas, USA, found that children suffering from acute leukemias responded favourably when they were treated with very high doses of leucocyte interferon, but failed to respond to the action of the drug when it was given in lower doses.

Side Effects

Investigators are very much concerned to note the side effects of interferon therapy on the human body. The side effects as have been investigated out in cases of young and adult patients, are found to be mild in comparison to other potent chemical substances often used in chemotherapeutic treatment of cancers. These effects, as witnessed in patients, are chills, fever and loss of appetite. In addition, some moderately serious side effects observed in some cases are suppression of bone marrow results in anaemia, inadequate immune response and sometimes change in liver functions, etc. But, fortunately, all these physiological changes are found to be reversible with the stoppage of interferon administration.

Growing Demand

The greatest impediment faced by the interferon—researchers globally to carry on large scale researches is the non-availability of adequate amount of this precious cell-synthesized substance. Two commercial laboratories have recently started producing human fibroblast interferon. The quantity, which is now being produced by these two laboratories, is far less to meet the minimal demand for basic and clinical studies.

To overcome the problem of this short-supply some research workers are now being engaged to work out more efficient device to produce the sufficient quantity of human interferon from cultured cells, while others are trying to search out other methods of manufacturing it.

Genetic Engineering in Interferon Synthesis

One of the methods now being attempted by some workers is to employ the recombination DNA technique for the complete chemical synthesis of human interferon. This will necessitate the introduction of human interferon genes into bacteria, which would then work as "interferon factories" provided these interferon genes are to produce the active interferon proteins. Furthermore, since interferon is a glycoprotein, the attachment of desired carbohydrate residue with the protein fraction of it would presumably be an uphill task. However, knowing all these problems and limitations, Pestka and Jan Vilcek of the New York University School of Medicine and several others have started working along this line.

Recent research on employing bacteria containing human interferon DNA to synthesize biologically active human interferon has yielded considerably favourable results. Professor Charles Weissmann of the University of Zurich has announced in January 1980 that he has successfully employed the genetically engineered *Escherichia coli* bacteria in the synthesis of human interferon. But the yield of this *E. coli* synthesized interferon is far too low for large scale production. Professor Weissmann believes that "if things worked out as hoped, we should have a high yielding strain within six to twelve months and we could then move relatively fast."

Till today nothing can be said for certainty about the underlying genetic mechanism governing the synthesis of interferon in the cells and its nature of actions on human malignant cells, though there has been some progress in these directions. Moreover, interferon will have to stand the test of large scale clinical trials before its acceptance as definite cancer drug. The basic and clinical researches that are now being undertaken are hoped to resolve in near future whether interferon would be universally accepted cancer drug or not. □

The Development of Biology Teaching in English Schools since Early Nineteenth Century

S. Prakash Singh
Chairman, Faculty of Education, Kamla Nehru Institute of Science and Technology Sultanpur, (U.P.)

The history of the teaching of science in English schools in any organized and widely accepted sense is relatively new. Except for some schools specializing in technical aspects (like the navigation schools) it was only 130 years ago that science first began to enter the higher grade elementary and some grammar schools. With the development of science and its direct application to technology and industry, the need for the teaching of science in schools grew so rapidly that by the beginning of the twentieth century a demand for 'science for all' arose both outside and inside schools. The post-World War I (after 1918) period was a favourable time for its rapid growth. Science established firmly its educative and economic values in the everyday life of England and in English society from food to warfare and welfare. Moreover rapid scientific advancement continuously widened the field.

Biological science as such, as compared with physical and chemical science came very late into the school curriculum. In the second half of the 19th century the biological science did not offer spectacular advances to catch the eye of the public and the headmasters, i.e. there was no such practical and direct application of the knowledge to factories and industry as was the case with physics and chemistry. On the other hand most of the schools were waiting and looking forward to teaching biology. Lack of adequate laboratory facilities and aversion to dissection, coupled with the difficulty of procuring zoological specimens and their preservation favoured the teaching of botany in this period. Next to botany came biology in popularity. Biology as such embracing the aspects of both zoology and botany and in close association with human life entered the field in the late 1870s. The summary of the syllabus for biology issued by the Science and Art Department in the late 1890s,[1] included some elementary knowledge of the frog, tissue and cell, blood circulation and a few lower plants like mucor and penicillium. An elementary knowledge of floral morphology and physiology was also included. But the treatment of the subject at both elementary and advanced stages demanded simple morphological and anatomical study. Very little emphasis was placed on the human aspects. However, the neglect of the subject during the 19th century can be better explained in the words of H. A. Peacock (1937) as follows:

> "Hence the neglect of biology appears to be due largely to historical reasons. By the time the value of science in the school curriculum was generally realised, physics and chemistry were ripe—biology was not.

> In the main no place for biology was found, no demand was created for teachers of biology, and all the available time was devoted to physics and chemistry".[2]

However, I do not agree with the word "ripe". I, personally, feel biology was equally ripe but the schools were unaware of its real attractions and were looking for others to set an example. Since it was not given equal status its development was limited and it remained in the elementary and lower forms of higher elementary schools as Nature-Study.

The third decade of the twentieth century shows marked changes in the attitude to biology. In terms of the School Certificate examination candidates (see the Table below)[3] it is evident that while botany, as a popular subject in the past, shows a gradual decline in popularity, biology grew from 1.2 per cent in 1918 to 23.5 per cent in 1937. This rise is, therefore, very rapid during the third and fourth decades of the century. Physics and chemistry show gradual decline expressed as a percentage, and by the 1949 almost the three subjects were equally popular and shared by the pupils.

The first half of the present century showed a trend towards the teaching of general science in secondary schools. Specialization in physics, chemistry or biology was not favoured. It was realised that a basic foundation as well as the idea of correlation of one science with another could best be obtained by teaching a course of general science including physics, chemistry,

TABLE 1

Percentage of Total Number of Candidates Entered for the S.C. Examination Each Year Offering Group

Subjects	*1918*	*1922*	*1925*	*1928*	*1931*	*1934*	*1937*	*1940*	*1943*	*1946*	*1949*
Elementary Maths.	94.5	93.0	93.6	95.6	94.8	95.1	95.0	89.8	88.7	87.1	85.2
Additional Maths.	7.8	10.0	6.3	4.1	2.7	2.5	2.1	1.4	2.1	2.3	2.5
Mechanics	3.3	2.5	1.8	1.7	1.0	1.2	0.9	0.9	1.4	1.5	1.5
Physics	26.8	32.7	33.4	39.7	39.9	43.0	40.1	34.0	33.9	32.0	30.3
Chemistry	45.6	48.7	47.1	50.4	50.2	51.1	45.8	37.0	34.3	33.6	31.9
Biology	1.2	2.4	2.7	4.0	6.6	13.1	23.5	23.4	25.2	27.8	31.4
Botany	27.2	27.9	28.1	24.7	23.4	16.9	10.3	6.0	3.5	1.9	0.9
Physics with Chemistry	1.8	3.3	8.7	6.1	5.7	5.4	7.1	6.2	5.9	6.6	7.0
General Science I	—	—	—	—	—	—	2.6	14.2	21.3	22.8	22.9
General Science II	—	—	—	—	—	—					

*Adopted from Table 2, "Some aspects of the growth of secondary school examinations" transactions of the Manchester Statistical Society 1947. The figures include the percentage of both male and female.

botany, zoology, geology and astronomy. The suggested syllabus for general science in the late 1940s, by the Science Masters' Association is given in the School Science Review (1953)[4]. The syllabus covers a comparatively wider field than that issued by the Department of Science and Art in 1894[5], and contains an element of social human life. Biology was not considered to be a subject applicable solely to girls or means of promoting the faculty of observation. The social and cultural value of biology along with its vocational and disciplinary values were greatly stressed.

The 1950s, saw a reorganization of the matter and the methods of science, owing to the rapid advances in science and technology. New avenues of knowledge were being discovered. The enormous development required a thorough revision of existing curricula and pedagogy. Indeed, curriculum reform and the urge for a new look at pedagogy is a general trend throughout the world. The success of the Russian satellite launched in 1957 stimulated the USA to review its high school science curriculum in 1959. This infused a similar tendency in other countries, and Britain followed in the early 1960s. The Council of curriculum study accelerated the work in collaboration with some private organizations, such as Nuffield Foundation. The new curricula in physics, chemistry and biology are being developed and tried out in actual classroom situations.

It is hoped that the changing curriculum should be wide in scope, flexible in approach, giving ample scope and opportunity to individual and group work, discussion, and training in scientific methods. The spirit of scientific inquiry is given greater emphasis to be developed in young pupils.

The work in curriculum development is also accompanied by a corresponding need for reform in examinations and the technique in evaluation along with changes in pedagogy suitable to the present needs of society and education. Examinations which have been the controlling factor in determining the curriculum of schools are under continuous revision. The aim of the new examination Certificate of Secondary Education—first held in 1965 is to maintain a national standard, allowing for the maximum possible local variation in syllabuses and the setting of standards which the average pupil could reasonably be expected to attain.

The above tendencies are closely associated with the development and evolution of the national system of public education in England. The emergence of a coordinated system of education and a widely accepted standard external examination during the 1920s, established the claim of biology in the school curriculum and encouraged its development considerably. The factors influencing the development and growth of biology in English education can be summarised in brief.

Administrative Influence

In early 1833 Parliament voted a grant for aiding schools run by voluntary bodies. Gradually the control was tightened through the examination and inspection by H. M. Inspectors of elementary schools. The creation of the Department of Science and Art in 1853 strengthened the hand of the government by giving aid to science schools on the basis of the results shown by pupils in examination held by the department. The Science and Art Department listed physiology as one of the examination subjects in 1859 and later in the late 1870s biology was also included.

In 1899 a "Board of Education" was created by an Act of Parliament to superintend public education. The Board of Education and the LEAs developed secondary education and attempted to evolve a National System of Education from 1920 onwards. The State instituted a number of inquiry commissions from time to time and thereby sought suggestions on different matters of interest. The 1944 Act recast the educational system and the present stages of primary, secondary and further education came into existence (although there are further signs of change at the moment, 1968). In the report of the Ministry of Education—Education 1900-1950, we read as :

> "The history of the past fifty-years in public education may be summed up as an endeavour to plan and build up a comprehensive system of education, not uniform or rigidly controlled, but placing within the reach of all children and young persons the best of which they are capable"[6] (Section 44).

The condition of the nineteen twenties is commented upon as follows:

> "The idea of a national system of education from the nursery school to the technical colleges or university was beginning to take shape, and the responsibility of the local education authority for providing a comprehensive system of education in cooperation with its neighbours was confirmed"[7] (Section 23).

The emergence of a National System of Education giving wider opportunities and the institution of external examinations coupled with the liberal provision of scholarships to deserving students stimulated the teaching of the sciences and biology as well. To improve academic standards the Board of Education instituted in 1917 two external examinations administered by university examining boards, for secondary schools : the first school examination (the School Certificate), and the second school examination (the Higher School Certificate). The syllabuses of these examinations included botany, zoology, biology and general science along with other science subjects. State scholarships for university study were also awarded on the results of these examinations. In 1951 the General Certificate of Education Examination (GCE) superseded the former School Certificate and Higher Certificate Examinations. To meet the differing abilities and needs of individual pupils of a wider ability range a committee known as Beloe Committee (after the Chairman of the Committee—Robert Beloe) recommended in July 1960 that a new examination partly based on the schools, be introduced. This report was the basis for the setting up of the Certificate of Secondary Education examinations which first came into operation in 1965.

Thus, the interest of administration in every pupil's education has added a stimulus for the reform of examinations as well as reform in the curriculum. The Council of Curriculum Study and the Nuffield Science Teaching Project are working in developing suitable curricula for pupils. The Nuffield Biology text for GCE O'level pupils is now being tried out in some of the schools. Other texts for average pupils, sixth form pupils are in the developmental stage.

Religious and Social Influences

The move for the teaching of biology in the early 1850s began with the demand for health and sanitation. The public health movement introduced human physiology as a subject in schools. Much later it took shape as a more comprehensive subject—biology—that included botany and zoology as well. Personalities like Combe, Huxley, Spencer and others faught the idea that biology was an immodest subject for young children and had no educative value. This belief was shaken and opposition against it gradually became weak and came to an end by the early 20th century.

Further, rapid development in industry and the First World War stressed the need for more cooperation and the understanding of the relationship between the human being and his environment and community. Religious opposition of the Churches were not always on social grounds as quoted by H. Alan Peacock.

> "Physiology, besides being costly and useless, is an immodest subject. When the Author of the Universe hides the liver of man out of sight He did not want frail human creatures to see how He had done it."[8]

The change in attitude towards the subject was certainly due to changes of social values. The development of science was itself one of the contributory causes bringing about a change of attitude in the Churches and society.

Cultural Influences

By cultural influence I mean the diffusion of knowledge (especially in biological sciences) throughout the world. In the late 19th century the growth of communications meant an increased acquaintance with world flora and fauna and a corresponding development of interest in the subject inside and outside schools. The work of Duthie—'The Flora of Upper Gangetic Plain' in India is a good example of work of the early twentieth century. Unesco (United Nations Educational Scientific and Cultural Organization and CELC (Commonwealth Education Liaison Committee) are two of the organizations at the present time providing opportunities for workers in the fields of sciences, curriculum, etc. from the countries of the world to meet together and discuss plan to help each other in educational progress.

Economic Influence

Foreign competition provided a spur to develop industries, technology and thereby paved the way for an acceptance of science teaching in schools. With flocking of population around the industrial cities and urban areas the British farmers were deprived of labour and were also able to use the machines provided to help. There were now less men working in the fields and yet agriculture was supposed to feed more men working elsewhere. This change in the balance of economy made the country realise the necessity for the teaching of applied biological sciences e.g. in agriculture, industries like fermentation, food preservation, pesticide pathology, etc. This economic influence has been felt even more keenly after the two wars of the present century. Biology, as other sciences, has played an important part, hence has grown in favour in schools as a regular class subject.

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Faster Fitting for Artificial Limbs

R. B. Lawrence
Deputy Director, Biomedical
Research and Development Unit
Queen Mary's Hospital, Roehampton, London

A new technique for making the sockets for artificial leges by a semi-automatic process is shortening waiting times from several months to a matter of days

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When people have a leg or an arm amputated, a socket has to be made to match the stump before an artificial limb can be fitted. Producing them has, so far, been expensive and time-consuming, requiring the skills of a team of craftsmen. Conventionally, the procedure is to carve the appropriate shape out of a block of wood, or to beat an aluminium alloy sheet to fit; a third, more recent technique, is to build up layers of glass-reinforced plastics, applied in the form of bandages, over a plaster cast of the stump. With considerable numbers of patients waiting to be fitted, delivery of a completed artificial limb may take months, and the finished article is even then not always shaped to the stump as accurately as it really needs to be to avoid undue discomfort.

For some years it has been apparent that the potential advantages of thermoplastics, which become soft and workable when heated, were significant if only they could reliably exploited. For example, thermoplastics sockets could be made in a small fraction of the time taken to produce the conventional ones, they would do away with corrosion problems, be more hygienic and would allow the cast shape to be reproduced with a high degree of accuracy. Moreover, they would be significantly cheaper.

Individual

Techniques for plastics forming require a mould or pattern, of the shape that is to be reproduced, into which the thermoplastic material is injected or formed. The cost of making such a tool and setting it up on a machine makes the technique uneconomical unless a large number of parts are to be made to that particular shape. But every patient has individual physical characteristics that have to be matched by the socket so no two sockets can have identical shapes; it is essential too, that each socket is a good fit. This rules out the usual large-scale production techniques.

Because the prosthetic socket forms a vital interface between the artificial limb and part of the body and is a load-bearing structure that must withstand high stresses applied in a complex way, merely reproducing the desired shape is not enough. The socket must be anatomically compatible to avoid damaging the tissue, and must have predictable mechanical properties, especially with regard to fatigue.

There are several ways of forming a thermoplastic material into a desired shape and there is a big choice of materials. When they are heated they soften, but harden again when they are cooled, so the forming process consists of softening the substance, shaping it and then cooling it to a rigid structure in its new shape. During the process, chemical and physical changes may occur which might adversely affect the mechanical properties even though the shape is correct. Materials offer various characteristics, with corresponding advantages and disadvantages. Theremoplastics consist of a basic polymer with various additives such as plasticisers, fillers and so on. The additives serve to modify the forming properties and eventual mechanical characteristics of the material, but they may themselves be adversely affected by the process unless it is properly controlled.

Change

The structure of the thermoplastic material inherently influences the mechanical properties that the socket will finally have, and the forming operation may considerably change that structure: for example, in partially crystalline materials the degree of crystallinity may be changed by the heat cycle, especially by the cooling rate. Furthermore, deformation and drawing almost certainly introduce anisotropic properties, that is, the mechanical properties of the material differ when measured in different directions. Forming and cooling may also cause stresses to become 'frozen' into the newly-shaped material. In addition, with many thermoplastics the deformation has to be performed within a critical temperature range if they are not to be severely degraded. All these factors have to be taken into full account.

The most obvious approach to our problem was to use a sheet of thermoplastics material and employ conventional, well-established techniques to form it by vacuum on to a replica of the patient's stump. The replica was a plaster cast that had been suitably corrected to ensure that the loadings on the various parts of the stump were acceptable. But the deformation of the material had to withstand was so large, and the variation in sizes and shapes of the sockets required was so great, that it was obvious there would be a high risk of introducing considerable differences in structure, which meant there would be sockets with unreliable mechanical strength. For example, extreme anisotropy can weaken a structure in certain directions by a factor of as much as ten. This coupled with the danger of large variations in wall thickness, meant that sockets made by conventional means would not be reliable enough in this application.

The problem was to find a process in which it was possible to control the amount of anisotropy and variation of wall thickness. We decided to develop pre-moulded thermoplastics cones that could subsequently be shaped in a specially designed vacuum-forming machine. The preform was to be of the size and rough shape of the required socket, thereby keeping draw ratios to a reasonable figure (the draw ratios are a measure of the deformation). It was also essential to control the forming conditions precisely, so that the best possible mechanical properties could be obtained by ensuring the optimum thermal cycle and deformation conditions. Such processing is beyond the scope of most machine operators, so the complete process had to be automatically controlled; there is now no need for any skilled operators at all.

We evolved the shape of the standard preform experimentally. And were able to find one size and shape that would do for all patients who had below-the-knee amputations. To produce above-the-knee sockets needed more than one size of preform because that part of the limb varies so greatly in size. We found that careful control has to be exercised during the injection moulding of the preforms, to make sure that they were of good, consistent quality.

The Machine

The forming machine that we have developed takes up an area of about one-half of a square metre. Its electrically-heated oven is servo-controlled; below it the cast stands upon a servo-controlled ram which has a small tube through it leading to the interface between the cast and the preform. The other end of the tube is connected to a vacuum pump by way of a control valve. The preform is placed in position over a hole in the base of the oven.

The entire thermal cycle, strain and cooling rate are controlled by a micro-processor system that reads a coded programme card and steps the machine through each part of the process until it finally turns out the formed socket.

There are a large number of materials that may be formed for our purpose. We compiled a short list of them after rejecting those that were obviously unsuitable through being, for example, not elastic enough, too brittle to withstand impact satisfactorily, or prone to fatigue in the working temperature range.

The material also had to be suitable for injection moulding and vacuum-forming, and capable of withstanding a double heating, cycle without undue loss of quality. After considerable experimentation, we selected one of the modified polypropylenes which, incidentally, was so cheap that the cost of a preform was only about one pound sterling. It is likely that there are other suitable materials. We are grateful for the support of the Polymer Engineering Directorate of the UK Science Research Council, and the Cranfield Institute of Advanced Technology, in assessing various materials and generally helping us in the project.

We have now been able to make sockets with excellent and reproducible mechanical properties. Their weight, about 0.35 kg, is less than half that of earlier types. The process takes about 15 minutes and the machine can be used continuously, unattended, once the casts and preforms have been loaded into it—a job that needs a special skill. At first we used microwave heating to dry the plaster casts quickly before the forming took place, but experience showed it was not necessary; the system quite easily copes with wet casts.

Trials

A clinical trial began in June 1977, on 12 patients who had undergone a below-the-knee amputation. It has since been extended to 25 patients. Some of them have now worn their sockets regularly for more than 27 months. All the patients are wearing the original polypropylene sockets that we supplied and so far there have been no failures, mechanical breakdowns or need for refitting. We tried as far as practicable to include a representative cross-section of patients in the trial, that is, patients with long, short and average stumps. In spite of the considerable range in the size and shape of the stumps, the one size of preform has been found good enough. The condition of all the patients' stumps is very good indeed, though several did join the trial with problems . The trial is being expanded to include a much larger sample of patients.

The new process has opened the way to making high quality sockets cheaply and quickly. This means that it is usually a great deal cheaper and quicker to make a new socket than to repair or adjust an old one.

Research is going on into other materials, especially their fatigue and deformation properties, and we intend to conduct a finite-element stress analysis of structures of various shapes and sizes. In a computer based analysis of this type, the stresses are calculated separately for each small element of the structure and integrated to give an overall result. This is expected to lead to still better mechanical properties and even greater confidence in the product. Research is also going on to introduce our general ideas and semi-automatic techniques to making complete artificial limbs. Eventually, we hope, limbs will be made cheaply and fitted on the same day that the cast is taken of the patient's stump.

COURTESY : *Spectrum*

Teacher as A Curriculum Changer

VED P. GOEL
DESM, NCERT
New Delhi

CHANGE IS a very familiar word in the field of education. Whether we listen to educationists or read the articles in newspapers and educational journals, everyone seems to be talking about educational change. Money is flowing into the field of education from federal governments, state governments, industry, private agencies and institutes of higher learning to bring about a change. One of the ways to bring about desired change in education is to change the curriculum. In the past many new curricula, both at national and state levels, have been developed. As a result of these curricular changes, the educationists claim of the pattern of education in the changing. They claim that now the process of education is emphasized over the product and individualized instruction over group instruction. But in fact the situation does not seem to appear to be so much comfortable. In the words of Heatners, "it would be accurate to describe today's classroom as teacher centred, group centred and fact centred. In most classrooms, teacher rather than child is central figure. Most frequently teachers work with group rather than individuals. In most of his times at school, the child is engaged in acquiring information rather than learning to understand and use".

Goodlad has also expressed his dissatisfaction over the present state of affairs in education by saying, "the much heralded pedagogical revolution is still largely in the cumulonimbus clouds of educational reform that rolls back and forth across the vast and varied land. These clouds have not yet enveloped the millions of schools to anything like the high degree claimed by many innovators and popular magazines".

Thus, if we trace the reason for this state of discrepancy, it will not be difficult to dig out that in the past the reforms in the curriculum were not initiated and understood by the teachers; that is why this state of affair exists. In this paper a position has been taken that teachers as a group should be given the leadership role for curriculum development.

Earlier Curriculum Projects

In the past decade the curriculum reform movement was focussed on academic scholarship, on the structure of separate discipline, on comprehensive package of instructional materials, and on in-service training of teachers. Most of the earlier curriculum projects were initiated by scientists who were motivated by subject matter deficiencies, the knowledge explosion and what Goodlad calls as, "cold war of the intellect rather than by a hot water of blood and bone". These materials were based on the assumption that either teachers could be prepared quickly to use them or could not defeat the intent of the materials in any way. A lack of involvement of teachers in the earlier curriculum development has been expressed by O'Toole, "in some cases it was an approach by someone else for removed from local schools. The teachers volunteered to participate in a training programme in one of the major curriculum programmes... The teacher was generally chosen to represent a cross-section of the student population. Seldom were more than two teachers from the same staff involved. This method was sound as far as research was concerned, resulting in data that would be generalized over a wide population, but certainly not sound from the point of view of implementation". As a result we find that many of the earlier curriculum projects which were considered good from theoretical point of view have been blunted at the classroom doors. Probably one restraining force derives from the fact that most of the leadership in curriculum reform movement of the late 50's and 60's came from outside the teacher organizations and education establishments.

Teacher's Role in Curriculum Development

It goes without saying that when radical changes occur in the curriculum or school system, it is the teacher in the classroom that is the active agent. As Milburn says, "It is because the little real change can't take place unless the teacher implements it in a personal and involved manner". So the first important thing for curriculum change is that the teacher should understand the reason for change, realize himself the need for change and be an active agent to bring about the change. This strategy is essential both for gaining confidence and adapting/adopting to new change. One of the easiest ways to achieve this strategy is to allow the teachers to play the leadership role in curriculum development. When the curriculum is imposed upon the teachers, they become confused; more so when a large number of new curricula are developed at the same time by different institutions and organizations and there is a rapid change in curriculum. The imposition of curriculum on the teacher is still worse when it is imposed with the assumption that the teacher is merely the consumer of the curriculum rather than the designer and developer. This view has been supported by Edmonds when he says, "The reform that may make a significant difference in education is a change in the role of the teachers from consumer of educational products to designers of instruction. Only a teacher who has chosen and planned his day to day activity can be accountable for student learning. The teacher designer finds it natural to be actively involved in his work with children and colleagues". So if we need any substantial worthwhile change in curriculum we should assign the responsibility of it to the teachers.

Even now if we look into the reality, we find that it is ultimately the teacher who designs or develops the curriculum in the day to day interaction with the students and fellow teachers. As Alexander says, "When a teacher closes the classroom door in the morning and is alone with the students, the real curriculum begins. It may have little resemblance to what the administrator thinks is going on." Thus it is primarily the teacher who decides what to teach and what not to teach. Then why not allow him the primary responsibility for this task permitting him to develop, select, adopt or modify the curriculum choose the appropriate content and design the evaluative measures needed. This view has also been supported by Clagg when he says, "We should encourage the creative and imaginative use of locally available resources from one's own community rather than follow slavishly the packaged material that too often has little involvement for either teacher or students". Therefore, all those who are interested in the education of the children should support the efforts of the local teachers in curriculum development.

Another greater advantage of teacher made curriculum will be that those teachers who participate in curriculum work remain within the school and are easily accessible to their colleagues everday. They would, therefore, be in a better position to adapt the curriculum to their particular school or school system. They would be able to facilitate ongoing adaptation so that change does not become merely a status quo.

Education of Teachers and Curriculum Change

As stressed earlier that until and unless the teacher is not conceived an agent of change or he himself has not felt the need for change in curriculum, no useful change can take place. Now the question arises how can the teacher identify the need for change and become an agent of change? Perhaps one of the answers to the question is the education of the teacher himself. If during his own education as a teacher, the facts and nature of change were stressed and he was helped to become an eager investigator of new content in his field of interest, the teacher to a greater extent will understand the change and will become the agent of change. This implies that if we want any substantial and useful change in curriculum, then the universities instead of developing the curriculum for schools, should concentrate on training the prospective teachers in such a way that they not only become just agents of transmission of knowledge but also producers of curriculum and other allied educational materials. There is no doubt that if sufficient opportunity to study newly developed curriculum and other materials are provided to teachers and their efforts are appreciated and supported by their administrators, they can become key not only in selecting new curriculum but in originating it.

Teacher Organizations and Curriculum Development

In the recent years several major attempts at shifting the loci of power over the curriculum have been discussed and one of them as described by Ronald Doll is "militancy by the teacher organization which has learned that when one begins to talk about the teacher welfare he must soon discuss organization of school and children's curriculum, both of which matters have previously been in the preserve of Boards of Education and their administrative staff". These days if we look into the mood of the teachers, it reflects that they not only want the greater involvement in curriculum development but want to eliminate department of education directives and to make their own individual decision about what shall be taught. The teachers now ignore the state and other curriculum developed by universities etc. and wish to develop their own within the existing constraints. Now-a-days they make efforts to make up their perceived deficiencies, updating themselves and satisfying the need for self-respect, by organizing various seminars, workshops and conventions. There is a great deal of professional motivation among the teachers. Professional motivation and identification with the profession has been described by Rowland as, "crucial to excellent curriculum development".

This further stresses that teachers, if not individually but as a group, should be allowed to develop the curriculum. We find that the teacher organizations have not been fully exploited of their potentialities in curriculum development. There are evidences that teacher organizations regard curriculum as a part of their wages, hours and conditions of employment since this has been negotiated a number of times. As Sand says, "the power of teachers in negotiation has hardly touched several important areas. For example, the potential of the organized teaching profession to improve the curriculum remains unexploited." He suggests the establishment of curriculum improvement centres at the level of the local educational associations, at the level of the teachers.

In the past the teacher organizations negotiated the curriculum with their administrators in the same way as the negotiations for salary, working conditions and so on and so forth. But as Young says, "the issue of curriculum has been settled in the context of adversary relationships accompanied by antagonistic confrontation". It does not mean that the teachers are incompetent, rather it was the defect of the strategy of negotiation. The negotiation approach that seem appropriate for welfare matters does not seem appropriate for curriculum matters. The optimum condition for productive curriculum development work requires a high degree of mutual faith, trust and respect among professional staff members and administrators.

In brief it may be said that if we want any worthwhile change to happen in the school, than the teachers should be allowed to develop their own curriculum. The teacher organizations should be exploited of their potentialities for curriculum development. Curriculum centres should be developed at the level of the teacher; at the local teacher organization offices. The efforts of the teachers should be appreciated and supported by their administrators and educators. The universities instead of developing curriculum for schools should train the teachers in such a way that they become an active agent of curriculum change. It is based on the assumption that whenever any curriculum changes, it is ultimately the teacher who has to act in a different way, change his values and shift his attitudes. The hypothesis is that if the teachers will be given the leadership role in curriculum development these changes will be achieved at much faster rate and change will be much more effective. ☐

From Poison To Food?

E. A. **Bell**,
Department of Plant Sciences
King's College, London

Plant synthesize and accumulate more than 24 amino acids which are not used in synthesizing the proteins that enable them to grow. Marg of the compounds are poisonous to other organisms; others discourage predatory animals or plants that compete for space, light and food. Plants that contain amino acids poisonous to man and his domestic animals may nevertheless become valuable sources of food or fodder if they can be modified.

PROTEINS ARE synthesized by, and are essential to, all forms of life. In man the collagen of bone, the actin and myosin of muscular tissue, and the elastin of blood vessel walls and the haemoglobin they carry are all wholly or partially made of protein, as are all the enzymes that catalyse the processes of life

Proteins in all living organisms are built up like strings of beads from about 20 basic units known as the protein amino acids. If we imagine that each of these acids is a differently coloured, bead, each protein can be seen as a unique, multicoloured string containing a fixed number of beads of each colour arranged in a characteristic order. An almost infinite number of different strings can be built up by varying the length of the string, the relative numbers of differently coloured beads and the order of the beads on the string.

The characteristic nature of each of the countless thousands of naturally-occurring protein molecules is fixed in this way by the type, number and sequence of protein amino acids in the molecular string.

Non-Protein Amino Acids

In addition to the amino acids incorporated into proteins there are a few others such as ornithine, saccharopine, homoserine and citrulline which occur widely and play a part in basic metabolic processes. But few natural amino acids are widely distributed and most have been isolated from plants and micro-organisms. They are usually referred to as the non-protein amino acids and are found in the free state or as simple condensation products such as acetyl, oxalyl or y-glutamyl derivatives. Over 240 have been characterized.

Some of the non-protein amino acids are close structural analogues of one or more of the protein amino acids, others are not. A number are toxic to, or physiologically active in, organisms to which they do not normally belong. Some interfere with the metabolism of protein amino acids in these organisms, others have different effects.

Non-protein amino acids are often accumulated by higher plants in massive amounts. The seeds of *Griffonia* (*Bandeiraea*) simplicifolia contain 14 per cent of 5-hydroxy-L-tryptophan, a close analogue of the protein amino acid tryptophan; those of *Mucuna* species contain up to 10 per cent of L-3, 4-dihydroxyphenylalanine, a close analogue of tryosine, and those of *Dioclea megacarpa* 13 per cent canavanine, a close analogue of arginine. The rhizomes of *Polygo-*

natum multiflorum are rich in azetidine-2-carboxylic acid, the lower homologue of proline, while the leaves as well as the seeds of *Leucaena leucocephala* contain high concentrations of minosine. Faced with these figures we may well ask why plants make these compounds and in such large amounts.

Rapidly-mounting evidence suggests that non-protein amino acids may be significant to plants in several different ways. The build-up of large concentrations of any compound by a plant suggests a possible storage role and we know that some, though not all, non-protein amino acids accumulated in seeds are metabolized during germination and seedling growth. But the ability of certain non-protein amino acids to poison animals, plants and micro-organisms suggests that at least some of them may confer a selective advantage on the plants that contain them by giving protection against predators or pathogens, or by discouraging plants of other species which compete with them.

Biochemically Adapted

High concentrations of a non-protein amino acid, or any other secondary plant compound for that matter, are unlikely to protect the plant completely from attack or competition, however, because predators and competitors, no less than plants synthesizing non-protein amino acids, are subject to the pressures of selection exerted by their environment. So it is to be expected that the chemical challenge provided by the toxic non-protein amino acid may well lead to predators or competitors emerging that are biochemically adapted to overcome it.

The larvae of the seed beetle *Caryedes brasiliensis* feed on the canavanine-rich seeds of *Dioclea megacarpa* and are able to do this because the arginyl tRNA synthetase (an enzyme that helps to incorporate arginine into protein) of *C. brasiliensis* is able, unlike the corresponding enzyme of most organisms, to discriminate against canavanine and exclude it from its protein. So, *C. brasiliensis* does not suffer through synthesizing pseudo proteins containing canavanyl instead of arginyl residues, and we have an example of an insect that has successfully adapted to food containing canavanine. Just as interesting is the fact that only the larvae of this insect eat the seeds of *D. megacarpa*, which suggests that even if canavanine is not completely protecting *D. megacarpa* against all seed beetles it is doing so against most.

It is probable that canavanine is important to other legume species in other ways. The roots of *Neonotonia* (*Glycine*) *wightii*, for example, exude canavanine at concentrations which inhibit the growth of seedlings in other species of plants. Canavanine is toxic at low concentrations to various bacteria, moulds and fungi. In contrast we have found that mice can take in relatively high concentrations with no apparent ill effect.

Another arginine analogue which is found in many legumes is L-homoarginine and this, too, is an example of an amino acid being toxic to some but not all organisms. Homoarginine is toxic to a variety of micro-organisms including yeasts, algae and bacteria, yet in mammals it is hydrolysed by arginase to give lysine, an essential protein amino acid.

Need to Qualify

These examples clearly show that the term toxic has no meaning unless it is related to the organisms that have been found to be affected. In the literature on so-called toxic or poisonous plants this fundamental fact is often ignored; so the word implies nothing more than toxic to man or toxic to an animal that is economically important to us. But even when we accept such a loose definition the non-protein amino acids are considerably important. Human lathyrism, a neurological disease characterized by irreversible paralysis of the legs and, in extreme cases, death, is found in areas of the Indian subcontinent where seeds of *Lathyrus sativus* or, less often, *L. cicera* and *L. clymenum* are important sources of food. The toxin mainly responsible for this disease is α-amino-β-oxalylami-nopropionic acid. Other species of the same genus have yielded α, γ-diamino-butyric acid, which induces ammonia toxicity in mammals by disrupting the urea cycle, and α amino-γ-oxalylaminobutyric acid, which, like its lower homologue from *L. sativus*, is a neurotoxin. *Lathyrus odoratus*, commonly known as sweet pea, contains the γ-glutamyl derivative of β-aminopropionitrile in its seeds and the free nitrile is given off by its roots. Both compounds are toxic and, in mammals and birds, interfere with the synthesis of collagen and elastin, thereby producing skeletal abnormalities and weaknesses of the blood vessel walls.

Hypoglycin A and its β-glutamyl derivative hypoglycin B, are found in the unripe fruit of *Blighia sapida* ('akee'); they cause 'vomiting sickness' and occasionally death among the peoples of the West Indies. This amino acid, as its name suggests, causes the blood glucose level in man and other mammals to fall. Nevertheless, if it is injected into the veins, the dose needed to kill a mouse is ten times that needed to kill a rabbit.

Non-protein amino acids that contain selenium, such as Se-methyl-L-selenocysteine, are highly concentrated in the green parts of various species of *Astragalus*, sometimes known as loco weeds; they cause neurological disorders in grazing animals and may kill them. Indospicine, found in several species of *Indigofera*, damages the liver of sheep, cows and rabbits and the foetuses of rats. Mimosine damages the liver of animals gvrang on *Leucaena leucocephala* leaves, and causes them to lose hair. The same plant gives rise to goitre in ruminants; the compound responsible is 3-hydroxy-4(1H)-pyridone, formed from mimosine by micro-organisms of the rumen.

Insects

Some non-protein amino acids are toxic to those beetle and moth larvae which eat seeds and leaves, and certain of them inhibit feeding in insects such as the desert locust. Attack by insects may have had a big influence on the natural selection of plant species which synthesize non-protein amino acids; their toxicity to other forms of life, including man, may in many instances be quite fortuitous.

A knowledge of the chemistry, toxicity and distribution of these compounds can be turned to practical use in agriculture in two ways. Firstly, it can be applied to improving crop plants which contain non-protein amino acids toxic to man and to domestic animals. Such plants may be valuable food crops, perhaps flourishing under poor conditions which make it difficult to raise other crops. Provided they do not contain more than a critical amount of toxin, such crops may play an important part as sources of food and fodder. Their potential dangers are often well recognized by the people who make use of them and in many societies water-soluble toxins are removed from the plants by soaking them for a long time before cooking them. From the earliest days of agriculture, moreover, crop varieties have been selected for desirable characteristics, including sweetness, size and lack of toxic effects, so it is common to find lower concentrations of toxins in cultivars than in wild varieties. But this empirical, hit-or-miss approach may take hundreds of generations to produce a low-toxin or toxin-free variety. Knowing what the toxin is and being able to screen large numbers of plants rapidly to determine the presence and concentration of that toxin should enable us to improve a crop dramatically within a few years instead of a few hundred.

An example of this is certain work done in India, where it has been shown that the seeds of some varieties of *Lathyrus sativus* have 20 times the amount of α amino β oxalylaminopropionic acid that other varieties contain. This amino acid is known to cause human lathyrism. Programmes to select for toxin-low varieties have now been instituted. In Australia, crossing *Leucaena leucocephala* with other species of the same genus has produced hybrid plants with less minosine. Genetic changes may also be brought about by exposing plant populations to radiation and/or chemical mutagens, giving us another approach to developing suitable varieties of species which are otherwise poisonous to some extent. All these techniques depend upon knowing what causes the poisonous effect, together with some way of finding out how much toxin we have to deal with.

Secondly, such knowledge is needed in developing new crops from wild species or from species which are rarely cultivated or used perhaps only as so-called famine foods. Studying the non-protein amino acids and other secondary compounds such as alkaloids and cyanogenic glycosides which they contain may well tell us why these plants are not put to more use. It may also indicate whether some could be improved to produce new sources of food in parts of the world where they are most needed. It might be a great dealmore easy, and need a lot fewer gene changes, to make a local species edible than it would be to introduce a food plant already established in a region with a different climate.

Resistance

If we remove a toxin that protects a plant from insects it is likely to become attacked and suffer badly. But from evidence that organisms vary greatly in their susceptibility to different compounds, it may be possible to reduce the toxicity to man while building up resistance to insects.

In practical terms, the study of non-protein amino acids and other secondary compounds is likely to bear most fruit in giving agriculturists and plant breeders, in various parts of the world, the basic information they need to improve certain marginal crops that they already cultivate. Such crops are already adapted to local conditions and the local people know how to grow them. It is better in many ways to do this than to introduce new crop plants from other regions.

COURTESY : *Spectrum*

Treating Mental Disorders with Lithium

R. C. Kapoor
Department of Chemistry
Christ Church College, Kanpur

The Curative properties of lithium, the lightest alkali metal as a constituent of mineral waters, was known to man since Roman times. But it is only in the past two decades that lithium salts have found application in the effective treatment of mental disorders. It was John F. J. Cade of Australia who in 1949 administered lithium orally to a number of human psychotic patients suffering from various mental diseases and noticed a marked improvement in the behaviour of ten patients suffering from mania. He further observed that even other mental patients who were restless, noisy, and abusive became quiet and amenable. Following Cade's observation lithium salts and lithium carbonate in particular were soon used by other investigators as an effective sedative for patients with acute psychotic excitement.

Winokur, Clayton and Reich in their book "Manic Depressive Illness" have reported that the basic symptoms of the manic phase are physical and mental overactivity—overtalkativeness, excitement, and rapid flights of ideas which lead to irritability or anger when the patient is frustrated in any way. This is then followed some time later (days, weeks, months or even years) by a depressed phase characterised by a prolonged lack of interest in the surroundings, lethargy, and slowing of thought processes which is sometimes accompanied by tension and anxiety. In some people, these feelings of futility and hopelessness may lead to suicide.

As stated above lithium carbonate is the usual salt of lithium employed in the treatment of various mental disorders and is administered orally to human patients as it is easily formed into tablets and is easily soluble. In some cases lithium citrate or acetate have also been used. The effect of lithium carbonate on aggression in humans was studied on twelve male volunteers in a United States maximum security prison, and it was observed that a daily dose of lithium caused a highly significant reduction in the symptoms of anger and tension in these inmates.

The very specific effect of lithium therapy in the treatment of mania is quite remarkable for it appears to be ineffective in most other psychiatric disorders such as schizophrenia, endogenous depressions and other psychoses. Experiments have also indicated that lithium has little effect on the normal mental state whilst patients maintained on it for ten years or more do not appear to change in tolerance, or to develop an addiction. Lithium treatment does not appear to affect clarity of consciousness. However, it has been reported that some patients appear to miss the excess energy and activity of the manic phase during treatment and tend to stop using the drug at the first opportunity. This tendency is particularly marked in creative people and usually results in the return of the manic attacks.

There are, of course, problems associated with lithium treatment as there are with any other drug. Apart from toxicity, especially in patients with heart or kidney diseases, a number of other undesirable side effects have been noticed, and hence it is now recognized that lithium can not be administered indiscriminately. Nevertheless, lithium treatment is well established and there is little doubt about the effectiveness of lithium therapy on mania. ☐

Students' Corner

LET'S PRESERVE SOME BEAUTIFUL FLOWERS

SHAKUNTALA BHATTACHARYA
National Council of Educational Research and Training, New Delhi

HOW OFTEN have you looked wistfully at flowers and wished to add colour and brighten up your room. You might have picked them and put them in a flower vase but they, most probably have dried up. Let us explore if we can preserve these flowers.

Hang-up-to-dry Method

You may have come across flower called 'everlastings' or 'straw flower' (*Helichrysum*) in shades of crimson, gold, orange, and brown. These are easily preserved by drying. The flowers should be hung in small tight bunches, upside down, in a cool, shady place where there is plenty of aeration. The bundles are best tied with rubber bands. They should be kept hanging for seven to fourteen days, depending upon the weather and the amount of moisture in the flowers.

Other plants that can be preserved by this hang-up-to-dry method are *Celosia*, *Amaranthus*, *Zinnias*, Golden Rod, *Gypsophila*, Queen Anne's Lace, Bouganvillea and Larkspur. The latter two should be hung in single sprays. Wheat and other attractive cereals, grasses, reeds and some of the more unusual seed pods like *Albiums*, poppies and some weeds may be dried this way. The seed pod of poppies lend themselves well to painting if you want to have certain colour schemes. For following this particular method the flowers may be best picked when these have just blossomed and the seed-head ripened. If the seed-head is over matured these may fall into pieces.

Drying with Granular Material

Many flowers would maintain their shape and colour if preserved in granular material, such as a mixture of clean fine sand and borax, or sand and silica gel mixture or silica gel. Flower drying is an old art, and for centuries people have been experimenting with various methods. But it was not until the invention of silica gel, which speeds up the process of drying, that one could produce dried flowers that retain the actual colours and shapes of live flowers. The basic requirements for these methods are fairly big air-tight tins or plastic containers and adhesive tape. An amount of granular material (Silica gel, or borax-sand mixture (1:4) or silica gel-sand (1:2) mixture), enough to fill the container upto a depth of about 15 cm or more depending on the size of the flower being dried is also required. Silica gel can be had from chemical dealers and borax from the grocer. Silica gel is reusable. It is best to buy silica gel which has moisture indicator added. Dry silica gel is blue. When it absorbs the maximum moisture the blue crystals will change to pink. Then to reuse the silica gel, it may be spread in a large open pan and placed in a 250°F oven for about an hour till all of the pink crystals have turned to blue. When not in use it should be stored in air-tight containers.

When flowers are in peak bloom and their surface is dry these may be picked for drying. It should not be picked after dew or rain. These should be placed on the drying material as quickly as possible. Single petalled flowers without thickened centres are most suitable, however flowers like roses can also be preserved this way. Orange and red roses keep their colours well, pink tends to fade and white turns to cream. Flowers with about 4-5 cms of stem should be picked. It is preferable to add false stems for arrangements. The container should be filled upto 5 cms with the granular material. Flowers may be kept face-up in it, and well spaced, so that they do not touch.

Slowly and *extremely gently* silica gel may be added over the flowers so that all parts of the flowers come in contact with the drying agent. It should fall in between the petals. During this entire process the shape of the flower may tried to be retained. The container may be closed and sealed with adhesive tape. In caseof sand and borax mixture the container should be left open.

There is no hard and fast rule about drying time; it varies with size, texture and moisture content of each flower. It is therefore, best to dry a single kind of flower in one lot. Time has to be determined by trial and error method. Some small flowers like daisies, pansies etc. take two days. Heavier flowers take from five days to a week. Flowers may not be taken out too soon—they may wilt if they retain the least bit of moisture. If left for a longer period, these become brittle and break easily. After periodic checks, if flowers are still soft, these may be kept for a while longer. When ready, flowers should be dry and crisp.

To remove the flowers, drying agent may be blown off. Rest should be removed with a soft paint brush. Flowers are now ready for use after fitting them with false stems.

Artificial stems may be easily constructed with wire and florists green tape. A hook may be made at one end through the middle of the flower and should be gently pulled down until it is concealed among the petals. If wire is not available flowers can be glued to the tip of a broom stick cut in to the desirable length with Fevicol. This is a stable arrangement. Flowers (especially roses) are quite fragile so these should be handled carefully. If petal breaks off, simply attach it back with Fevicol spread thinly with a toothpick.

Other Methods of Drying

Fern leaves and delicate flowers may be dried by pressing between sheets of blotting paper. Old newspapers may be used as substitute for blotting paper, however use atleast three or four sheets between each layer of material. Material should be fresh but not wet. Ensure that leaves are not badly folded when drying.

Hydrangea, and similar flowers dry well if stood in 1.5 to 2 cm of water and left until all the water is gone.

Preserving with Glycerine

Leaves of trees can be preserved by treating with a solution of glycerine and water (one part glycerine to two parts warm water, well-stirred). Glycerine can be easily obtained from chemists shops. Choose branches with good arrangement of leaves. Leathery leaves are particularly suitable e.g. Magnolia etc. Before standing it in the glycerine-water, all material should be cleaned Split up the stem ends of hardwood branches so that they may better absorb the solution. A depth of 15 cm of liquid is sufficient. Should it all be absorbed add more. Ivy can be preserved by dipping the whole material into the solution.

Most foliage is ready in two to three weeks time. Plants with thin leaves take less time. Should the leaves start to droop, remove it from the container and hang it upside down to recover.

Using Preserved Leaves and Flowers

Beautiful flower arrangements can be made using preserved material. Besides these dried material meadows parks, and forests abound with plants which produce nuts, burrs, cones and other types of beautiful fruits. Collect them when you see them, they will come in handy when arranging the flowers.

Two methods of fixing flowers and leaves may be applied. First is to fill the container with sand and stick the flowers into it, very much as you would do for fresh flowers in water. Other is to put a large piece of thermocole to fit the container and stick the stems carefully into this. If we are using preserved material along with fresh flowers and leaves, then we should dip the stem of the dried flowers inmelted wax. This coat of wax would stop them from rotting when these come in contact with water. A flower arrangemont, if preserved under a glass dome in absence of dust, its freshness is retained longer. It may not be possible to get a large dome but we may certainly make some elegant paper weights and small decorations by using the glass globe of an electric bulb.

Storing Preserved Material

Once the material is dried or preserved they can be stored in boxes, or if very fragile, in vases and then covered with plastic bags to prevent accumulation of dust. The materials should be kept in a dry dark place until required for use. To prevent leaves from curling during storage spray or coat the underside of the leaf with a thin lacquer.

Preserved flowers are good as gifts and decorations. Give your favourite person an everlasting bouquet or a paper weight with a flower. They make good greetings cards and pictures too.

☐

How good are you in Science ?

1. A joint as in the elbow or knee, which allows movement in one direction is
   (a) a ball and socket joint
   (b) immovable joint
   (c) partially movable joint
   (d) a hinge joint
2. A disease of the respiratory system, such as pneumonia is usually contracted through
   (a) water
   (b) air
   (c) contact
   (d) insects
3. The digestive juice that begins the digestion of proteins
   (a) saliva
   (b) intestinal juice
   (c) pancreatic juice
   (d) gastric juice
4. A hormone produced by the pancreas is
   (a) insulin
   (b) thyroxin
   (c) adrenalin
   (d) androgen
5. The main protein found in wheat flour is
   (a) gelatin
   (b) casein
   (c) gluten
   (d) ricin
6. The scientific name of any organism consists of two parts indicating
   (a) family and species
   (b) class and species
   (c) genus and species
   (d) family and genus
7. A clear substance which transmits light without scattering them is
   (a) transparent
   (b) opaque
   (c) translucent
   (d) diffuse
8. The electron rich pole of a battery is the
   (a) diode
   (b) triode
   (c) anode
   (d) cathode
9. The unit used to measure heat energy in a substance is the
   (a) calorie
   (b) lumen
   (c) watt
   (d) volt
10. The number of protons contained in the nucleus of an atom is the same as
   (a) atomic weight
   (b) atomic mass
   (c) atomic number
   (d) atomic formula
11. The letters used to indicate the name of an element are known as the chemical
   (a) formula
   (b) symbol
   (c) reaction
   (d) equation
12. Elements that are placed after uranium in the periodic table are called
   (a) inert elements
   (b) transuranium elements
   (c) tracer elements
   (d) metallic elements
13. In which of these cases will electromagnetic induction not occur
   (a) a battery is connected to a loop of wire held near another loop of wire
   (b) A battery is disconnected from a loop of wire held near another loop of wire
   (c) A magnet is moved through a loop of wire
   (d) A loop of wire held in a steady magnetic field

(e) A loop of wire is moved across a magnetic field

14. Match the letter of the correct term in column I with its definition in column II

Column I	*Column II*
(a) Algae	1. Green plants that produce seeds in cones instead of in flowers
(b) Fungi	2. Microscopic single-celled plants lacking chlorophyll
(c) Amphibians	3. Group includes mushrooms
(d) Arthopods	4. Filaments or sheets of single-celled plants having chlorophyll
(e) Bacteria	5. Animals having saclike body and tentacles but devoid of heart
(f) Colony	6. Large group of bacterial cells in culture
(g) Coelenterates	7. Soft bodied animals that are usually enclosed in a shell
(h) Pines	8. Tubelike animals having the first true body systems
(i) Fission	9. Method of reproduction by dividing in half
(j) Anaerobic respiration	10. The most highly developed vertebrates adapted to live entirely on land
(k) Molluscs	11. The first group of vertebrates adapted to live entirely on land
(l) Mammals	12. Break down of sugar which produces CO_2 and alcohol
(m) Reptiles	13. Jointed leg animals making up the most numerous animal phylum
(n) Worms	14. Mold excretion which stops bacterial growth.
(o) Streptomycin	15. Vertebrate animals that spend part of their life in water part on land

15. The conservation of the biosphere has emerged as a crucial subject today. How well are you aware of the definitions of certain common words used in discussing the subjects? Mark each statement true or false.

(a) Areas in which animals are protected from man's destructive activities are called *game preserves*.

(b) The final community that continues with little change over a period of time is known as a *biotic community*.

(c) Trees that shed their leaves each year are the dominant plants in *evergreen forests*.

(d) Pampas velds, Steppes are examples of *grasslands*.

(e) The natural environment of an organism is called its *habitat*.

(f) The one-celled organisms making the greatest mass of food in the oceans are called *nektons*.

(g) Colour adaptations that help animals avoid enemies are called *mimicry*.

(h) The shallow off shore part of the sea is the *littoral* zone.

(i) The number of all species of a particular plant or animal found in a specific area is a community.

(j) *Conservation* is the wise and considerate use of the earth's natural resources.

(k) *Erosion* is the using of valuable minerals by plants growing in the soil.

(16) Depletion is the loss of soil minerals by water seeping through the ground. We live in a space age. A new vocabulary is therefore in constant use in daily papers. Test

your knowledge of space age definitions by making each of these statements true or false.

(a) *An artificial satellite* may send information about space conditions back to earth.

(b) *A refracting telescope* uses a concave mirror to form an image.

(c) *A communications satellite* sends out a series of radio signals that can be used to determine the location of a ship or plane.

(d) A rocket that carries an instrument package into space is called a *sounding rocket.*

(e) An instrument used to determine the elements found in stars is the *photoelectric cell.*

(f) A satellite that will receive and rebroadcast television signals is called a *navigational satellite.*

(g) A *radio-telescope* receives and records signals produced by distance stars.

(h) A *spectroscope* is an instrument used to determine the colour and age of stars.

(i) A condition of weightlessness experienced by a man in a space-ship is due to *zero-gravity.*

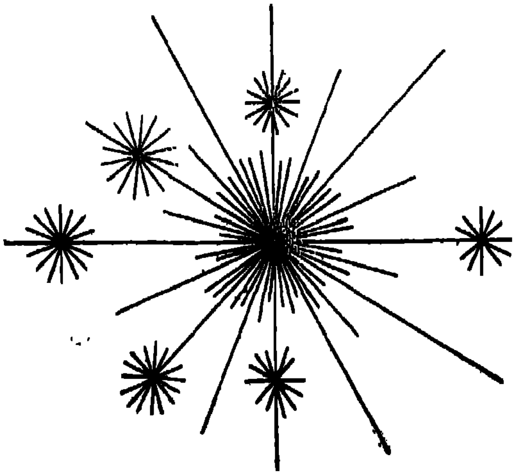
(j) A *reflecting telescope* uses convex lenses to form an image.

(k) The purpose of a *space-probe* is to collect scientific information.

Answers:

1(d); 2(b); 3(d); 4(a); 5(c); 6(c); 7(a); 8(d); 9(a); 10(c); 11(b); 12(b); 13(d); 14(a)(4), b(3), c(15), d(13), e(2), f(6), g(5), h(1), i(9), j(12), k(7), l(19), m(11), n(8), 0(14); 15 a(T), b(F, climax community), c (F, deciduous forests), d(T), e(T), f(F, planktons), g(T), h(T), i(F, population), j(T), k(F, depletion), l (F, leaching); 16-a(T), b(F, reflecting telescope),
c(F, navigational satellite), d(T), e(F, spectroscope), f(F, communications satellite), g(T), h(F, photoelectric cell), i(T), j(F, refracting telescope), k(T).

Science News



Jupiter's 15th Moon

A mysterious shadow in a picture snapped by the Voyager I spacecraft has led to the discovery of a 15th moon in orbit around Jupiter, the National Aeronautics and Space Administration said. It is second new satellite located by the pair of Voyagers that swept past the planet last year. The other was found by scientists in a photo taken by Voyager II.

The new satellite, temporarily designated 1979 J2, was identified by Dr. Stephen Synnott of the Voyager Optical Navigation Team at NASA's jet propulsion laboratory in Pasadena, California. Dr. Synnott recently was searching Voyager I images relayed on March 5, 1979, just 4½ hours before the spacecraft made its closest approach to the planet, when he noticed "a shadow stepping across the face of Jupiter where no shadow should have been"; NASA reported.

By studying other transmitted images, Dr. Synnott located evidence of the satellite in seven other photos and was able to calculate its size and orbital path. He said that the 1979 J2 is 69 to 80 km in diameter and that it orbits Jupiter every 16 hours. 16 minutes at a distance of 150,240 km above the cloud tops. It is between the orbits of the satellites Amalthea and 10.

Sun's Contraction Rate

New Research suggests that the sun is shrinking, but possibly at a rate slower than previously estimated, says the scientist who suggested the shrinking theory. Dr. John A. Eddy said that new information indicates he may have been wrong about the rate of shrinkage, but most of the data seem to point to the sun's contracting.

"I do not think we know the rate of shrinkage" said Dr. Eddy, a solar specialist at the National Centre for Atmospheric Research in Boulder, Colorado. "Everyone's rates are different and may be we are all wrong, but the important thing is the shrinkage" he said in a telephone interview.

A controversy over the shrinking sun arose in 1979 after he and a mathematician published their theory. They analysed solar diameter data recorded at the Royal Observatory in Greenwich, England, between the years 1836 and 1953 and at the U.S. Naval Observatory since 1846.

The scientists concluded that the sun's diameter, measured horizontally, was shrinking at about 2 arc seconds per century, or about 5 ft (150 cms) per hour.

Although this rate seems to be slow it would be fast enough for the sun to shrink out of existence in 100,000 years if the shrinking went unchecked.

New Genetic Treatment Technique

Scientists at the University of California (UCLA) at Los Angeles said they inserted a new gene into cells from the bone marrow of mice and then proved that the gene could function when the cells were reintroduced into living animals. "This is the first demonstration that one can put new genes into the cells of living animals", said Dr. Martin J. Cline of the UCLA School of Medicine, who headed the experiments. A new technique for inserting a substitute gene into a living animal foreshadows direct genetic treatment for sickly cell anaemia and other inherited blood disorders.

"The genes that one could put in might have a variety of uses. They could be useful in treating genetic disease, or they may improve the treatment of cancer where the bone marrow is a target of (anti-cancer) drugs", he said.

The UCLA scientists used a recombinant DNA technique developed by Richard Axel of Columbia University to insert into mouse cells a gene for resistance to the anti-cancer drug methotrexate. Like most anti-cancer drugs, methotrexate has the bad side effect of attacking vital bone marrow cells that renew the blood.

Only a few of the mouse cells picked up the drug resistance gene. But when these cells were put back in living mice, they multiplied to fill 70 per cent or more of the bone marrow as long as the mice were kept on small regular doses of methotrexate. This happened because the new cells, which could withstand the drug, had a competitive advantage over the normal to the bone marrow cells, which were more susceptible drug, Dr. Cline said.

The technique might be used eventually to help cancer patients tolerate higher doses of drugs. But potentially more important, was its possible use to treat sickle cell anaemia, thalessemia and other diseases where a gene defect prevents the bone narrow from making normal blood cells.

To do this, doctors would take cells from the patients own bone marrow and insert two new genes—one to correct the defect and the other for resistance to some drug. The cells would then be put back and the patient would take small regular doses of the drug. Over many months, the new cells with the healthy gene would gradually replace the patients own genetically defective cells because of the competitive advantage of drug resistance.

Ill-effects of Formaldehyde

Formaldehyde is an irritant to human beings and there does not appear to be an exposure level low enough to guarantee that none would be affected, according to a U.S. National Academy of Sciences Study.

A wide variety of consumer products contain formaldehyde. The largest use is in home building products, including particle board and plywood. The chemical also is used in cosmetics, shampoo and in making permanent press fabrics.

The report, written for the Consumer Product Safety Commission, says that formaldehyde's most documented health effects are—irritation of the eyes, respiratory tract and skin. There is preliminary data suggesting the chemical may cause cancer in rats, but not in mice.

Because so much is uncertain about health effects of the substance, "the committee recommends that formaldehyde be kept at the lowest

to be then amidst hunting scenes. The wild animals painted are rhinoceros, bison bulls and small animals like reindeer. The weapons shown in the paintings include bows and arrows, stone lances and other stone weapons like axes and blades. While most of the paintings are in red, a few are in blue, which are rare.

Professional Blood may be Hazardous

Blood from "professional" donors carries hazards of hepatitis, malaria and syphilis, according to Dr. J. B. Jolly, Head of the Department of Blood Transfusion, postgraduate Institute of Medical Education and Research, Chandigarh.

He said 60 per cent of blood for transfusion came from professional quarters. The use of this "sub-standard" blood was as harmful as that of adulterated drugs. The gravity of the situation arising out of the 'unwarranted' trade in blood was among the matters discussed at an international symposium on diseases transmitted through blood transfusion.

Dr. Jolly, who is also president of the Local Blood Bank Society, said professional and voluntary blood donors differed in their philosophies. While the volunteer made no bones about his medical history, the professional donor was secretive about it.

The aim, as such, was to achieve a total dependence on voluntary blood donation by the end of the year. The other factor vitiating safety in blood transfusion, according to Dr. Jolly, was lack of proper technique needed to screen the blood to secure 'safer' quality. Not a single fool proof laboratory test has so far been worked out in the world. In India, even the make-do resources were not available in most of the blood banks. Dr. Jolly said the rigid yardsticks adopted by the developed world in selecting blood donors were not applicable in the tropical countries.

If we do apply them, he said, we might not have even a single drop of blood in our banks. "As a compromise, we have to be realistic and work out our own criteria".

Why Tea and Coffee are Stimulants ?

Two Canadian scientists reported that they have discovered the mechanism which gives tea and coffee their reputation as stimulants and why some of the commonly used tranquillizers have the opposite effect.

Professor John Phyllis and Dr. P. H. Wu of the University of Saskatchewan have been studying the biochemistry of the brain for several years, with attention particularly focussed on the activity and effects of a chemical called adenosine produced naturally by the body. In a report released by the university, the two scientists said they felt their research could have important clinical applications to help develop effective stimulants and improved drugs to control anxiety and convulsions.

Working on animals the researchers found that adenosine and related compounds significantly reduced the firing of cells in the central nervous system, diminishing nervous excitability.

Coffee and tea have the opposite effect, but until now the way these two work has not been satisfactorily explained. Caffeine and theophylline, the active ingredients in coffee and tea, block the effects of adenosine, the two claim.

It appears, in other words, that adenosine and related compounds normally keep central nervous system activity under control but that drugs in coffee, tea and other such products as colas and chocolates prevent the controls from acting, with the result that nervous excitability increases. Professor Phyllis said that stimulants in coffee or tea, can cause anxiety, sleep disturbance and withdrawal symptoms with some people and may be related to hypertension. But, tolerance varies widely among individuals. After working with minor tranquillizers it appears that drugs such as those sold under brand names like valium and librium enhance the levels of adenosine, suppressing the firing of cells in the nervous system.

Vanishing Birds

Many species of birds have disappeared from China, huge areas of land in Pakistan have turned salty and fishes have vanished from Malaysian rivers owing to pollution by palm oil wastes. These and several other environmental problems faced by the developing countries in South Asian region were highlighted at the recent seminar on "environment, resources and media" held by the International Press Institute in Delhi.

The three-day seminar made it clear that pollution problems in this region are mounting at a rate too fast for the nations to find solutions to solve them. Mr. M. K. Ranjit Singh, the regional adviser to the UN environment programme at Bangkok said he counted only 18 species of birds in his 4,800 km journey in China. Overuse of pesticides had wiped out fruit-eating and ground laying birds from China leaving only a few sparrows, he said.

While the export of palm oil has boosted Malaysia's economy, its scientists have yet to find ways to treat the palm oil wastes from 120 factories which have polluted the rivers of the Klein Valley. In Hongkong, water has become scarce and the heavy influx of population has raised the cost of land to Rs. 30,000 a square foot. With construction projects going on 24 hours daily, it is the world's noisiest city, the seminar was told.

Urban migration in Indonesia has made the city of Bandung devoid of greenary. Some 10,000 students held a bicycle march recently in Bandung to focus the problem of environmental degradation.

The seminar was told that soil erosion caused by swift flowing rivers is posing a serious threat to Nepal. The rivers carry away thousands of tonnes of top soil into India and Bangladesh and if the erosion is unchecked, Nepal would look like Afghanistan in 20 years, according to expert opinion.

Deforestation has also become the number one environmental problem in Sri Lanka where rain has become erratic possibly due to vanishing forests. Five million hectares of Asian forests are lost every year and "millions more degraded by improper use".

National Parks

The Kashmir Wild Life Department proposes to set up three national parks in the State during the Sixth Plan period to save some species facing extinction. The project envisages an expenditure of over Rs. 1 crore, according to the State Wild Life Director, Mir Inayat Ullah.

A 300 sq. km national park, to be named after the famous Budhist Hemis, Gumpa is proposed to be set up on the Indus river in the arid region of Ladakh. Situated about 40 km southwest of Leh, the park will provide a sanctuary for the Bharal (blue sheep), snow leopard, wolf, red fox, Himalayan marmot, Indian hare and the great Tibetan sheep.

The number of blue sheep in the region is said to be 750. The 140 sq. km Dachigam sanctuary, about 21 km from here, is also being developed as a national park. The sanctuary has been the home of the world famous Kashmiri stag for centuries.

Another national park, the biggest, is proposed to be established in the Kishtwar region of Jammu. It would be about 1,900 sq. km in area. Its altitude will range between 1,700 metres and 3,400 metres. The region is the habitat of the black bear, stag, markhor and musk deer.

Drug Addiction among Medicos

Drug addiction among the medical undergraduates of the Government Medical College, Patiala, has increased at a rate of 10 per cent per annum over the past three years. A team of psychiatrists found that 71.7 per cent Patiala Medical students use drugs. Of these 82.3 per cent are boys and 29.6 per cent girls.

In 1977, 48.4 per cent of the students were drug addicts. Of the 750 students selected for the study 58.4 per cent were alcohol addicts. The ratio between male and female students stood at six to one.

Nomadic Schools for Nomads

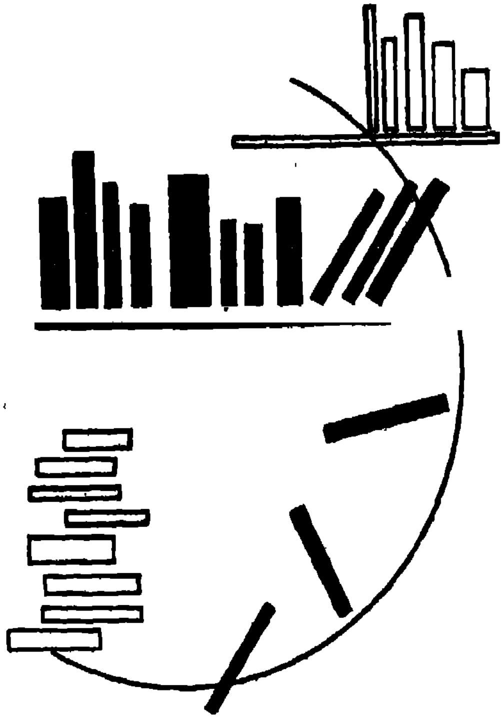
Jammu and Kashmir is probably the only State in the country where a school follows the nomadic population of Gujjars and Bakarwals. They wander in the high mountains in summer and come down to plains in winter with their cattle herds in search of green pastures. But they are followed by mobile schools set up by the State Government to provide elementary education to their children.

This arrangement has been working for the last few years and is aimed at the uplift of the community which has remained backward, socially and economically over the centuries.

A government spokesman said their literacy rate is far below the state average of 18 per cent. The schools provide education up to primary level to the community without interfering with their traditional occupation of cattle-rearing.

The number of such schools has risen to 80 with the opening of 32 schools in 1979-80. The average roll in mobile school varies from 30 to 50. Mobile schools are started by the State Government in a particular area on the recommendation of women members of the advisory board for the community.

Book Review



Essential Ideas in Inorganic Chemistry

D. E. WILSON, Hodder and Stoughton, London, Sydney, Auckland, Toronto.

THE BOOK under review deals with inorganic chemistry at 'A' level. The author has taken into account the recent changes in syllabus prescribed by different boards. All efforts have been made to give the factual material in terms of tables which perhaps is an easy method of expression.

Physical principles by which the properties of inorganic compounds are classified and predicted have been discussed in easy and understandable manner. Figures and flow sheet diagrammes are self-explanatory. Some of the questions raised at the end of the chapters are interesting and thought-provoking. The author has tried to explain 'why and how' in chemistry with the help of several examples. The book as a whole provides a fine blend of descriptive chemistry and general physical principles.

Physical principles such as atomic radius, ionization energy, electron affinity, melting point, heat of vapourization, eathalpy of vaporization have been discussed with the help of graphs.

The reason of group V metals being comparatively soft has been discussed in the heat of atomization. Solubility which simultaneously depends on lattice energy and hydration energy is dealt with in a lucid manner. The usefulness of aluminium has been discussed very nicely keeping in view the basis of the small size of aluminium and oxygen ions.

The existence of carbon dioxide as a gas as single covalent molecules is attributed to the high bond strength of C=O bond as compared to C-O bond in comparison to the silicon dioxide which exists as a solid. The oxides of nitrogen exists due to the availability of non-bonding electron pair on nitrogen while the oxides of phosphorous are based on P_4 tetrahedron found in the vapour phase. The carbon cycle and nitrogen cycle give an interesting study.

Many ionic oxides and sulphides exist although extra two electrons are required for oxygen and sulphur to make an octet which is an endothermic process. The necessary energy for ionization is recovered by small size and double charge. The formation of both, positive and negative ions of hydrogen has been discussed on the bassis of enargetics.

The book as a whole presents a good and comprehensive idea of inorganic Chemistry.

SUMAN BALA MALLIK
N.C.E.R.T.
New Delhi.

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The Social Responsibility of the Chemistry Teacher

D. J. DANIELS
University College of Bahrain
Bahrain
Arabian Gulf

THE LAST TWO DECADES have seen the development worldwide of many new chemistry curricula for the secondary level, nearly all of which have been charactrised by an increased academic—and even esoteric—content. The same period has witnessed a relative decrease in students, especially the more able ones, taking chemistry degrees in many countries. It is my contention that this is an example of cause and effect and that to motivate more able students to consider courses and careers in chemistry it is necessary at the secondary level that chemistry should be seen to have relevance to the students.

What then does the modern student seen as relevant? The burning issues seem to be pollution, environmental conservation and social awareness and successful chemistry teaching must therefore enable students to see connections between the subject-matter and social concerns. In addition to what students see as relevant it is in any case an important part of our task to develop a sense of social responsibility in our pupils and to produce citizens and consumers who are aware of the pros and the cons relating to scientific developments so that they can make rational decisions in the face of the conflicting barrage of opinions presented by the media. Several attempts have now been made in various countries to take examples of the significance of chemistry and to show how by a consideration of health, well-being, sociological, economic, geographic and related factors the chemistry itself takes on more meaning to the able and concerned pupil.

Overall Acceptability

In the June 1979 issue of the School Science Review, there is a very relevant article by W.G. Burtons[1] in which he suggests that pupils should be asked to identify all factors relevant to a particular case study and to categorise them into social and political, industrial and economic, environmental and personal. Each factor is then evaluated on a scale as shown :

10	factor highly acceptable
8	
6	region of intermediate acceptability
4	
2	factor does not contribute to situation or contribution is balanced between acceptable and unacceptable
0	
—2	
—4	
—6	region of intermediate unacceptability
—8	
—10	factor highly unacceptable

acceptability

and a summation made. A positive result suggests overall acceptability whilst a negative one indicates an unacceptable situation.

Case Studies

He then outlines three useful case-studies: the "poisoning of Michigan" in which 1000 kg of polybrominated biphenyls accidentally got into animal feed; "Minamata 'Disease'" as a result of mercury poisoning and "The Seveso story" in which 1500 kg of trichlorophenol and 2, 5 kg 2, 3, 7, 8—tetrachlorodibenzo-p-dioxin were accidentally discharged to the atmosphere. For each case-study some of the relevant factors are listed; for example, some factors relevant to the Seveso incident are:

Social and political

Seveso has become an undesirable place to live.

Community life has been disrupted by evacuation of residents and the presence of guards.

The incident may have affected the passage of a sensitive abortion Bill through the Italian Parliament.

The incident may have affected the balance of power in local government.

The herbicide has found a use in warfare

Industrial and Economic

The factory provided employment

2, 4, 5-T has helped farmers combat weeds.

Medical treatment for the victims has been expensive.

Compensation to victims will be expensive.

The cost of decontamination will be high.

Environmental and personal

A large area of land has been destroyed.

Local people have lost pets and livestock.

People may go through life feeling less well than they should because of TCDD.

What is it like to grow up with a face disfigured by chloracne? A family may produce and have to bring up a deformed child. A woman may have to face the prospect of having an abortion or producing a deformed baby.

The major failing of these examples seems to be that, even if pupils evaluate the factors and give a final positive rating, the negative aspects of chemical industry are given undue prominence by selecting accidents for detailed study. After all, accidents are the exceptions rather than the rule and we should perhaps concentrate more on the norms of industry, although affording due mention of problems encountered.

Coincidentally the same issue of the School Science Review gives an account more on these lines in an article by S. C. Rust[2] entitled "Soaps and Detergents—a 'social' treatment". In this he outlines how one could tackle this theme historically and in terms of scientific developments and associated improvements in pollution control; pupil experiments are included in his approach, which concludes with a discussion of concern for the environment caused by the inclusion of phosphorus and boron compounds in modern detergent formulations—a good example of where social responsibility and an ability to evaluate the advantages versus the disadvantages is important.

Industrial Case-Study

An interesting industrial case-study is provided by the production of ethanol by fermentation of molasses. This latter contains about 50 per cent sugar and can be fermented in the well-known way using the yeast Saccharomyces cerevisiae to yield a solution containing some 11 per cent ethanol at a conversion efficiency of about 80 per cent. This solution is subsequently concentrated by distillation and a "slop" containing some 13 per cent solids by mass is left behind. One can build a discussion around this process in which the economic value to the sugar industry is highlighted, together with the socio-economic implications of transporting the molasses and other raw materials to the site of the factory and the industrial uses and social problems associated with the end-product. An obviously important by-product is the carbon dioxide produced in large quantities and used inter alia in the soft drink industry and as a refrigerant; in this latter context it is used for keeping miners cool whilst working underground. In South Africa, for example, this thus provides a link with a very important economic base of the country.

Ecological Effects

However, what is perhaps more interesting is what happens to the "slop". In South Africa, disposal as liquid affluent into a local river was entirely ruled out by local regulations—and rightly so as the biological oxygen demand of such material is naturally extremely high. Attempts were made to burn the material but the resultant smoke and smell were unacceptable and the company were thus compelled to find a use for it. The solution was found in spray drying the material and later adding to the product maize meal gluten wheat bran, mono-calcium phosphate urea and salt. Under the trade name of "Rumevite" this material has shown promise of revolutionizing the beef industry by preventing the loss in mass and condition of animals during winter feeding and formulation plants are now also operating in the UK, Australia, Venezuela and Zimbabwe. In contrast the Brazilians have recently begun to operate a similar plant and are disposing of their "slop" direct into the local river with consequent catastrophic ecological effects.

There are some further interesting case-histories in "Chemical Industry: Social and Economic Aspects" by F. R. Bradbury and B. G. Dutton[3] including one of topical interest at this moment namely the development of tetraethyl lead as an 'anti-knock' reagent. Curiously this is also taken up by C. B. Hunt[4] in the June 1979 issue of the School Science Review in an article entitled "Chemistry and the Internal Combustion Engine". Here the author sets out ultimately to describe some chemical aspects of the internal combustion engine, to view some developments in their historical and social contexts and to illustrate the compromises resulting from the interplay of technological and socio-economic factors.

Food Availability : A problem

An aspect of chemistry which could well be given more attention in schools is the potential for good which it holds; many pupils might be awakened to the fascination of the subject if they could see more clearly the fields in which they might be able to make socially significant discoveries: currently, world population is doubling every thirty years, thus producing a problem of food availability—a problem not unknown in India. Chemistry might contribute to the solution of this problem by improving birth control methods, by supplementing food resources either by producing new foods, or by developing new fertilizers and by finding chemical ways of slowing down or stopping bio-deterioration. According to Bradbury and Dutton, annual losses due to fungi equal to 2 per cent of the whole industrial output of N. America and Western Europe, whilst the rodent population of the USA consumes or damages food equivalent to $9 per worker (1972 prices); a second field pregnant with potential is that of biologically acceptable methods of disposal of cartons of various types but especially those made of plastics, whilst environmental control by techniques such as chemical seeding of clouds still needs much development work.

Perhaps also the principles incorporated into high school syllabi could be illustrated by examples from the field of pharmaceuticals and the chemical background to issues such as drug use and abuse could be stressed, whilst over-riding all other areas of concern at present must surely be that of energy and it must be part of the chemistry teachers' job to make pupils aware both of the magnitude of the problem and of the social consequences of not solving it. An awareness of the importance of petroleum as a chemical feedstock compared with the extravagance of using much of it purely for travel needs to be emphasized—especially in the USA judging from published information—whilst the public should be made more aware of alternatives such as the Lurgi process for producing oil from coal as performed so well in South Africa, and the potential of solar, tidal and wind energy. This must be as important a part of a scientific education for the average citizen as, say, a knowledge of atomic orbital shapes as required by so many syllabi in various countries!

Removing Pollutants

Basic chemical ideas and techniques can be linked well with social concern in a consideration of water resources. The shortage of fresh water is acute in many areas of the world and desalination by such methods as electrodialysis, reverse osmosis and flash distillation is likely to assume much more significance in the next decade or two. The chemist is also called on to devise ways of removing pollutants from effluent water such that it will have no significant detrimental effect on plant and animal life and to ensure the satisfactory condition of recycled water. Typical consent conditions for discharge into streams are:

Constituent	Maximum allowed (mg l^{-1})
Biological oxygen demand	20
Suspended solids	30
Sulphide (as S)	1
Cyanide (as CN)	0.1
As, Cd, Cr, Cu, Pb, Ni, Zn, individually or in total	1
Free chlorine	0.5
Oils and greases	10
pH	5—7
Temperature	30°C

These provide a challenge both to the chemist controlling discharge and to the analyst monitoring such discharges.

More Awareness

In essence therefore, my message is simple; the chemistry teacher must himself or herself be aware of areas in which colleagues have to make decisions with social consequences and must instil in pupils the need for thoughtful appraisal of the social effects—both positive and negative—of chemical advances. Pupils who can accept this more challenging approach to chemistry will, in my view, ultimately get more satisfaction from their studies and wish to take up the practice of chemistry as a career.

We also need to think again whether it is ultimately in our pupils' best interests to study the various sciences, and indeed other related subjects, in isolation from each other. The examples I have given only make sense when discussed in a broad interdisciplinary context and perhaps we should really be covering many traditional disciplines under the one subject of environmental science.

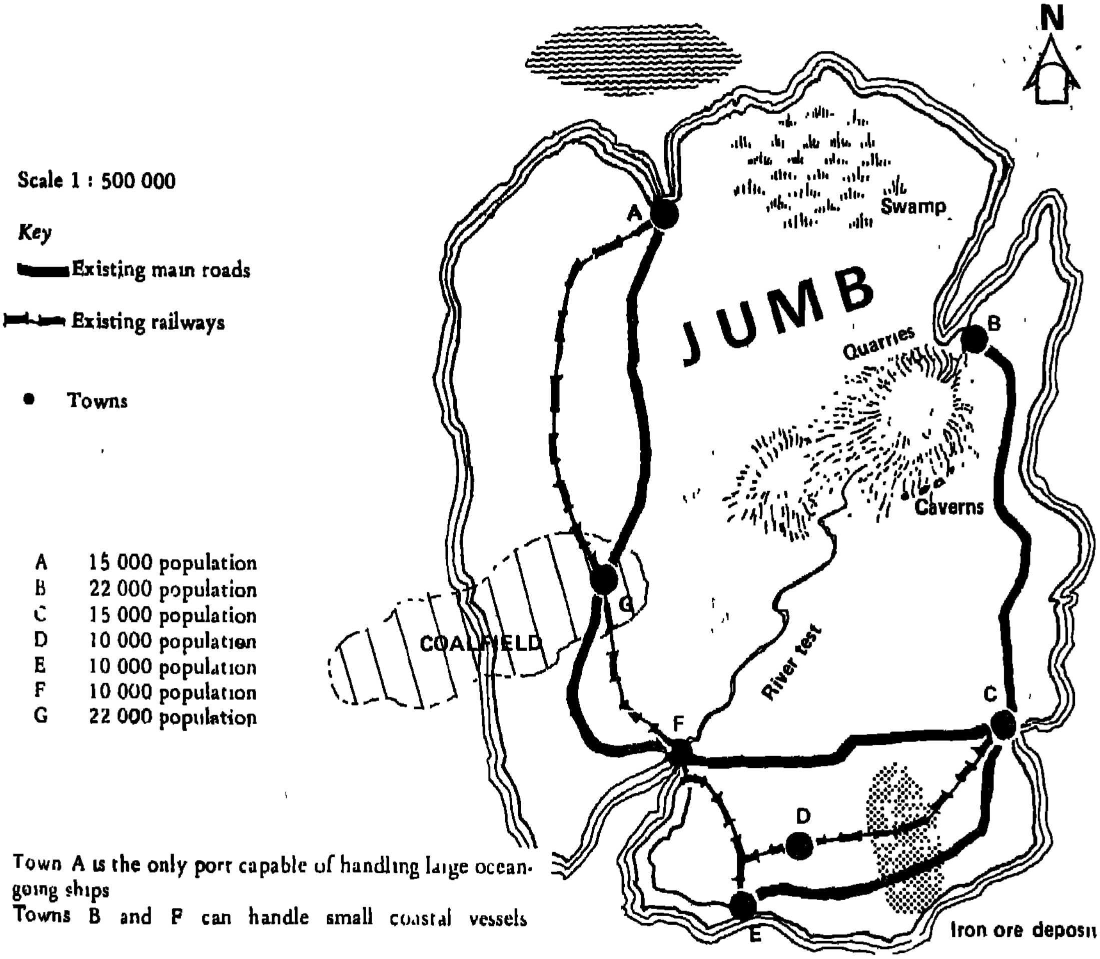
Making Chemistry more Relevant

There are now many materials available to help teachers make their chemistry more relevant. These sometimes take the form of practical projects as described by Daniels and Tomlinson[5] or as simulations and case-studies, of which several now exist,[6] or as games which combine chemistry and industrial issues.[7] Surely suitable subjects for such material would be both Sindri and Tata, although before materials of this type will be freely used in school teachers will need an assurance that examination questions will reflect the philosophy outlined above. This has now happened in the UK and I conclude this article by quoting a question posed by an English examining Board.

The following map is of a fictitious island, Jumb, which lies some 350 km south-east of a friendly industrial state, Terania.

Jumb is scenically attractive with a craggy coast indented by many small bays with sandy beaches. The area of limestone hills has a small region of spectacular caverns. In the north, the swamp region harbours several species of plants which grow nowhere else in the world together with a population of small reptiles which are uniquely adapted to the specific environment. During July and August many Teranians visit Jumb for their holidays and visitors are beginning to come from other parts of the world. The eastern coast and the adjacent hills are becoming particularly popular with tourists.

The population of Jumb is 140,000, with the towns marked on the map housing almost all the people. Coastal fishing was a major industry but in recent years the catches have decreased to a point at which only a small amount of subsistence fishing is carried out. There are small manufacturing industries in each of the towns providing for the consumer needs of the population, but, apart from coal-mining,



Town A is the only port capable of handling large ocean-going ships
Towns B and F can handle small coastal vessels

main employment is seasonal in agriculture and tourism. The deposit of sulphur-containing iron ore in the south-east of the island has only recently been discovered and the government of Jumb is anxious to develop a steel industry because Terania is willing to buy all the steel which Jumb can export. Such a development could provide additional employment in steel production and result in the development of light industries.

(a) Explain where you would recommend the construction of a steel works employing 4000 men. Give reasons for your recommendation and state why you would prefer your site to others which might be alternatives.

(b) Suggest what pollution problems might arise from the development of a steel industry and discuss ways in which the dangers could be reduced. Give special attention to measures which could be taken to preserve the island's amenities for the development of tourism.

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Environmental Concern —A worldwide Movement

J. S. Gill
DESM
National Council of Educational Research and Training, New Delhi

Man appeared on this earth millions of years later than other organisms. Since then his play with the environment has been on the increase and if continues at the present rate perhaps he will be among, if not the first, the few unfortunate species to disappear from the scene. The list of man-made environmental problems is not only unending but is expanding at a jet speed. The environmentalists attribute the present state of affairs mainly to the exploding human population, unplanned urbanization and indiscriminate use of natural resource.

The environment is a wide term and is used in very broad sense rather loosely by free lance environmentalists. Scientifically speaking it has two main components physical (abiotic) and biological (biotic). Man, being a part of the biotic environment, has proved to be a successful and enough intelligent species as far as the manipulations of the environment are concerned. One should, thus not be surprised to find that man rather than any other organism had been a major threat to the environment and at present to himself. The glaring examples of his involvement in the ecological crisis are armed conflicts, nuclear weapons chemical warfare and ruthless use of nature's resources. Another a purely man's creation and upcoming worldwide threat to the environment is the increasing acidity of the rain. The automobile exhausts, industrial emissions release oxides of nitrogen and sulphur which in the atmosphere combine with moisture and form sulphuric and nitric acids. This is probably the reason, says a report, of declining visits of the migratory birds like mallard and pelicans to the Bharatpur lake.

The worldover concern for environmental problems dates back to 1972. The year witnessed a historic conference on Human Environment held at Stockholm in the month of June. The notable contribution of the conferences as a part of the worldwide movement on environmental preservation and protection was launching of celebration of 5th June every year as a World Environment Day (WED).

Force behind Worldwide Movement

Before going into the mission of Environment Day celebrations it is interesting to look into history of such a worldwide movement. The 1972 Stockholm conference on Human Environment was attended by representatives (especially decision-makers) from 113 governments, environmentalists, large number of inter-governmental and non-governmental agencies, press correspondents and other environment concerned people.

The available information after a thorough political and scientific screening was categorized into following six areas technically referred as subject areas.

1. Planning and management of human settlements for environmental quality.
2. Environmental aspects of national resource management.
3. Identification and control of pollutants of broad international significance.
4. Educational, informational, social and cultural aspects of environmental issues.
5. Development and environment.
6. International organisational implications of action proposal.

The main theme 'Only One Earth' of the twelve day (5-16 June) Stockholm conference stressed the fact that man is a part of complex and interwoven system widely known as environment. It called upon him to behave responsibly towards the other components of the system. Tireless efforts of the working groups for about two weeks on the various aspects of environment especially the threats from the activities of human beings, enabled the conference to arrive at following thoughtful, scientific and action oriented recommendations.

1. Human Environment Declaration (HED) was drafted for adoption by UN general assembly and national governments on the pattern of Human Rights Declaration. It emphasizes the need of clean and healthy environment for each individual. This document with preamble is elaborated into twenty-six principles which cover the important aspects of various environmental issues such as development, planning for wise and judicious use of renewable and nonrenewable resources, conservation of nature, wild life species especially in the endangered list. The other aspects of environment like population, urbanization, need for environmental education, flow of information etc. are also included in the declaration.
2. It also recommended the establishment of a body with representatives of various governments in the form of governing council to manage the United Nations Environment Programme. The setting up of Environmental Secretariat to coordinate the worldwide activities related to environment was also decided and first one was proposed to be at Nairobi, Kenya.
3. The conference decided to have an *Environment Fund* starting with 100 million dollars for helping the various agencies working with local as well as global aspects of the environment.
4. In order to reiteriate its recommendations and to focus the attention on various environmental issues from time to time the conference called upon the national governments to celebrate 5th June of every year as World Environment Day The idea was to make the citizens aware of their environmental problems and also a caution to environmentalists and others specialists. Every government and its agencies, non-governmental organisations, educational institutions, free lance environmentalists and also the individuals are called upon this day to focus the attention on environment and its crisis. Although the fifth June every year has a message for general awareness but one particular theme relating to environment is highlighted during the celebrations. The themes for the last three years are

1978—Protect from pollution your only Environment
1979—Only one future for our children-development without destruction
1980—World conservation.

Agencies involved and Their Role

Our country has National Committee on Environmental Planning and Coordination (NCEPC) which is responsible not only for coordination of various environmental programmes but also for advising the government to arrive at the right decisions through scientific approach to various environmental issues. It operates from the Department of Science and Technology (DST) of Govt. of India located in Delhi. Being under the very strip of busy Palam airport it is subjected to the deafening noises of jets and other aeroplanes. The sound of 85 decibels or more affects the ear adversely. The decibel level in these areas goes upto 97-100. Our government on recommendations of NCEPC have instituted a National Environment Fellowship. It is awarded on 5th June every year for period of two years and carries amount of Rs. 2,500 per month and 5,000 contingency. It is awarded to Indian citizen for undertaking advanced studies leading to better understanding of environmental conservation, preservation and protection. This year's fellow Dr. S. K. Jain will investigate and study the endangered species of plants facing extinction.

On the advice of specialists groups our government has already enacted Atomic Energy Act, 1963, Insecticide Act, 1968, Wildlife Protection Act, 1972 and Water 1974 (prevention and control of pollution) for checking the environmental degradation. There is a move to enact air pollution act enforcing it for industries too.

The department of science and technology has also brought out postage materials with the help of Post & Telegraph Department. The special cancellation made on 5th June, 1978 bears a message 'Protect from pollution your only environment'. Twenty-paise envelope released on this year's World Environment Day has a picture depicting the structural and functional components of the environment. Efforts have also been made to distribute various posters at block level in various parts of the country to draw the attention of everyone to environment. The department has also brought out some booklets on environment and its problems. The following ones are available for free circulation :

1. You and your environment
2. Life giving water
3. Threatened environment
4. The cradle of our existence-a study of earth's environment.

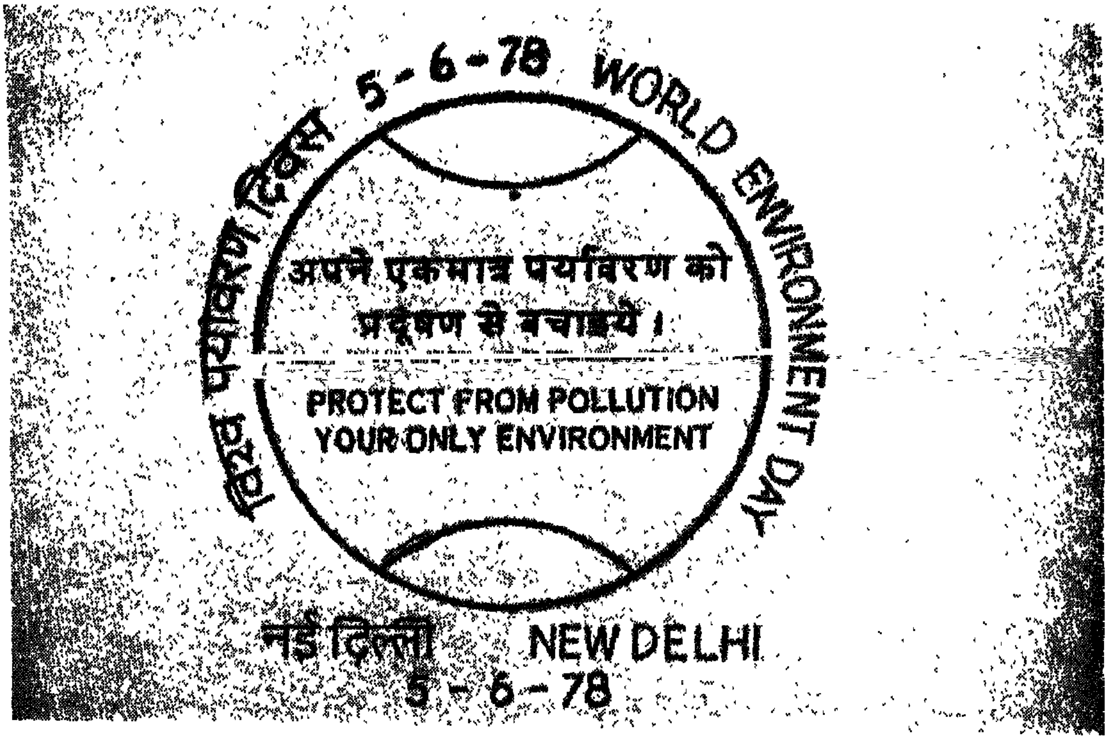
These government agencies besides offering expert advice to government also organize country-wide celebration of WED every year. They finance the various research projects and other activities related to environment. Though these agencies are doing their best to highlight the environmental issues and trying to seek their solutions but it seems that they have to still go a long way. One feels really hurt by reading a statement by a decision maker that Ganga can never be polluted. This is not only the isolated example but definitely a one from the list Environmentalists are accused of being against development whenever they express their genuine feeling for ecological balance. The silent Valley Project in Kerala has become a burning issue where the environmentalists are seeking protection to unique flora and fauna of the area. One the other hand the installation of power plant is also the need of the state The controversy remains unresolved either way.

Another case of malplanning, may be environmental planners have overlooked, is the location of the Jawahar Lal Nehru University and other educational institutions in the close vicinity of landing strip of the busy Delhi Airport. The students have to strain their ears and the teacher has to strain his vocal cords when plane is landing. The people in the area do feel the impact of noise pollution and are probably unaware of the long lasting damage to their hearing system. Interestingly enough the school of environmental sciences of university situated at highest point on the campus has never raised their voice or if they have done so may be it was when a plane was passing.

Another institution on the endangered list is the office of the World Health Organization (WHO) which coordinates the activities related to health. The building is often masked by the thick smoke coming out of the chimnies of Indraprastha thermal power station of Delhi.

Non-Governmental Agencies

The significant role played by some voluntary organisations is worth mentioning here.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PROTECT FROM POLLUTION
YOUR ONLY ENVIRONMENT
नई दिल्ली NEW DELHI
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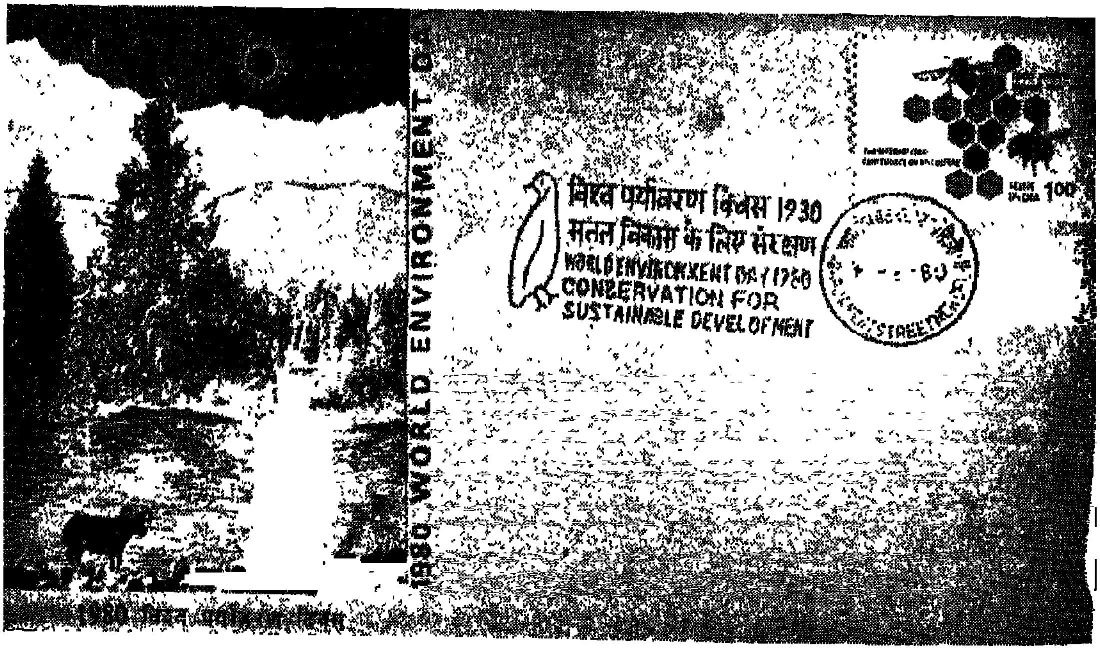
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Gandhi Peace Foundation a voluntary organization has 'Environment Cell' which publishes a monthly newsletter 'Environment', to highlight the burning issues of environment. In June, 1978 they organised an exhibition on Mahatma Gandhi and Environment. Large number of other agencies involved in the activities are Bombay Natural History Society, Clean Environment Society, Bombay, Indian Environmental Society, Nature's Clubs etc. At the international level United Nations Environment Programme (UNEP), International Union for Conservation of nature and Natural resources (IUCN), World Life Fund (WWF) in collaboration with Food and Agriculture Organization (FAO), UN and Unesco have launched World Conservation Strategy on March 6, 1980. Otherwise also these organisations are truly environment conscious and are putting their best for maintaining ecological balance in the various parts of the world. It is both on economic as well as social fronts.

Impact

The outstanding achievement of the Sotckholm conference, one can see, is the remarkable attitudinal change observed among environment technicians. They are now more concerned for local problems of their countries. This home coming approach is a big welcome and credit goes to the conference. It may not be out of place to mention here our prime minister's address to Stockholm conference where she emphasized 'while each country must deal with that aspect of life which is most relevant to it'. She further added that it is obvious that all countries must unite in an overall endeavour. That is alternative to cooperative approach on a global scale to the entire spectrum of our problems.

Though large number of national governments including ours have separate departments or committees to look after the environment and it related aspects in respective countries but the role of individuals, community and educational institutions is not to be minimized and underestimated.

Another significant observable change since early seventies is the efforts of the curriculum designers to give environment biased education both at school as well as university levels . The curriculum developed by National Council of Educational Research and Training is environment based in primary and middle levels. The secondary and higher secondary school syllabi especially in biology are quite rich in ecological knowledge. Unfortunately most of the universities have half-hearted approach for incorporating ecological vis-a-vis environmental component in higher education and research studies. Some are pursuing it for its sake. The universities have also started updating, though at snail's pace, the curriculum by giving due share to the environment/ecologoy components.

Further Scope : The researchers from specialized environmental and ecological fields should come up with more experimental data about the environment so that the ecological principles can be taught in a more effective and comprehensive way both in schools and colleges. At the same time the feeling of students about ecology being a dry and boring subject can also be dispelled.

The environmental experts present a very grim picture of the environment which is actually not so. They everytime emphasize the role government should play in solving the environmental problems. Unfortunately the role of individuals and community are always overlooked. The impact of Chipko movement makes one believe that the environment can be protected and saved from degradation at the common man's level also. One does not really need environmental technocrats. These experts should percolate further down to people from the discussions, seminars, press conferences which benefits that too theoretically none than the very little percentage of our population. These people rarely come out with the efforts possible to be made at the individual level. For example, why not suggest to the farmer the way he can check loss of irrigation water through seppage and bad drainage? Why not call upon the individuals to use water, electricity whenever they need it otherwise turn them off?

People become indifferent to environment when they read hollow slogans, high sounding recommendations of seminars and conferences. The experts should reach the people actually facing environmental hazards with remedial measures instead of getting together and discussing it in conferences, which do not help the victim. Such functions need not only be discouraged but also efforts and funds should be channelised to practicable applications. Otherwise with all their best intentions and efforts the environmentalists may be accused of polluting the environment.

The large population of our school and college going youth misses the opportunity of participating in worldwide celebrations of Environment Day owing to the summer vacation. Though subject Area IV of the Human Environment Conference deals with educational, social and cultural aspects of environment yet the decision-makers have given no thought to the involvement of students. It may not be advisable to suggest changing the world environment day to the time when educational institutions are open and working. Definitely one can suggest the celebration of Indian Environment Day on some other date and involve the students in the same. Though the celebration is for a day but it may not be taken in literal sense. A year long activities involving more and more people will definitely be more satisfying. May be it is Indian Environment Week (IEW) so that poster exhibitions, sketch competitions can be organized in schools.

The World Environment Day celebrations have awakened same citizens but still very low percentage. The movement is spreading fast. The day is not far off when international agencies like UN, UNEP will launch World Environment Year or Year of the Environment. Let us hope it comes faster than expected. ☐

Kitchen Garden Mushrooms

M. P. Sinha
Department of Science
Regional College of Education
Bhubaneswar

During the last few years many reports and articles have appeared in various journals on mushroom, but no article gives the proper method of cultivation of mushroom for the common man. Sometimes the method given in the journals is totally bookish. Union Government also realized its economic importance and a mention was made in the budget (1979-80) They declared that the cultivation of mushroom will get income-tax relaxation. But the problem is how to cultivate them. In some parts of our country mushrooms are being cultivated but those cultivators are not common men. The first cultivator is the pathology department of Himachal Pradesh Agriculture University at Solan; it is an institution; second cultivator and exporter is the Maharaja of Patiala, he is an institution in himself. In 1976 at the National Symposium on mushroom he was honoured as the father of Indian mushrooms. Other places where mushroom is cultivated on experimental basis are Bhubaneswar, CFTRI, Coimbatore, IARI, New Delhi, etc. This is because people do not know how to cultivate. In Delhi and Srinagar some private people started cultivating mushrooms but they are not common men, but high-ups, mostly retired army personnels. Some villagers have taken it up in Kashmir valley. This is for only one species. For this too, the Regional Research Laboratory and Agriculture Department of J. K. Government are always with them. Temperature is favourable to them for the species under cultivation, namely *Agaricus bisporus*.

Mushroom cultivation is profitable if cultivated properly. There are three species of mushrooms cultivated in India. These are the *Agaricus bisporus* or the European Button Mushroom (EBM); the *Chinese* mushroom (paddy straw mushroom), *Volvariella volvacea/diplasia*; and the Japanese mushroom or the *Pleurotus sajor-caju*. The first one (EBM) is cultivated in north India from November to February and is exported. This requires low temperature and long complicated composting method. So it can never be cultivated by common man. Neither it can be cultivated throughout the year even in north India. Of course, it gets the maximum price in the market, fresh as well as dry. The other two can be cultivated in any part of our country under a shade where direct sunlight does not reach. The *Volvariella* species can be cultivated from March to November and the *Pleurotus sajor-caju* can be cultivated from December to February. This is because the first one is a summer mushroom and the second one is the winter mushroom. Both are being cultivated easily by usual labourers in author's mushroom shade.

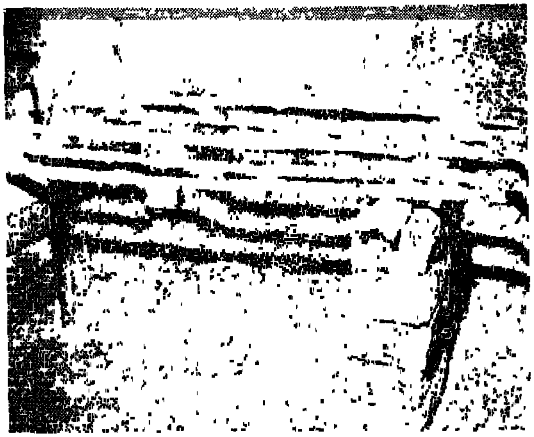

Fig. 1. A plateform for mushroom bed

Cultivation of Volvariella Species

Requirements: Fifty bundles of paddy straw, 25 full size bricks; 7 bamboo strips of 1.5 metre each, 250 gm of dal powder; 2 bottles of spawn for each bed

Preparation of bed : A platform of bricks and bamboo strips should be made as shown in the photograph (Photograph 1) Dip or drain the straw bundles in water for twelve hours. Drain out excess water for another twelve hours. Open the bundles and spread a layer of straw on the platform but only in one direction you choose This layer will be nearly 20-25 cm thick. Now break the spawn bottle carefully, the whole spawn will be in your hand. Take little bit of it and implant them under the straw on the platform not very deep; say 2.5 cm leaving the outer margin nearly 10 cm. Spray little of dal powder (any gram dal powder) around each implanted bit of spawn. Cover this layer by another layer of straw crosswise to the first layer. Repeat the entire implantation on second layer; put crosswise another layer, repeat implantation and cover the third layer by another top layer with straw. Always cross the earlier layer. Press gently the entire bed which will be now nearly 90 cm in height or thickness (Photograph 2). Trim the bed with a scissor from all sides. Leave the bed for forty-eight hours. Preferably lay your bed in the evening. This will check immediate and rapid evaporation. From third day sprinkle nearly 500 cc of water on all the surfaces of the bed including the lower surface once daily. Keep the room (any other place) open for at least five minutes or maximum half-an-hour daily for ventilation. Between 10-12 days the buds will come out. On the nature of spawn mushrooms must sprout between 13-15 days. Harvest them when they have not open and remove completely from the base giving a twist. The first harvest will be nearly 1-1.5 kg. Second and third harvest will come with an interval of seven to ten days and yield will be less Keep your mushroom bed and its area clean.

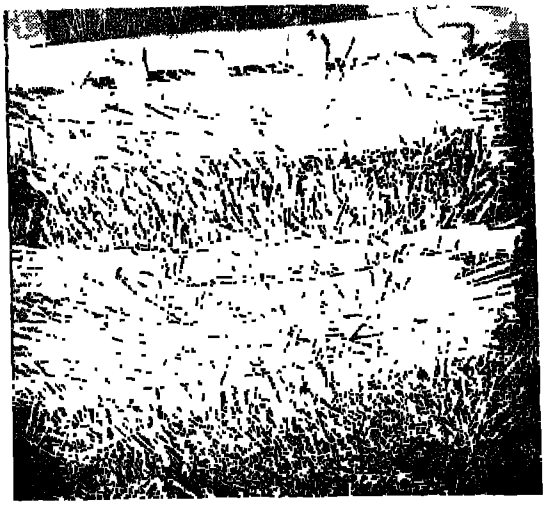

Fig. 2 An implanted bed

In nature mushroom may grow on dirty places but they are very susceptible to infections. With this mushroom sometimes other mushrooms also grow. You should see that your mushroom looks as in the picture (Photograps 3-4) and its lower surface pink before its use in your meals. Avoid any mushroom which turns its lower surface black within twenty-four hours if left unplucked. Use only fresh mushrooms.

Pleurotus Sajor-Caju

This can be cultivated during the month of December-Feburary.

Requirements : Fruit baskets or fruit boxes. 4-5 Kg of chopped straw of paddy, 2 bottles of spawn and 250 gm of any gram dal powder.

Preparation of bed : Like in the earlier case dip the chopped straw of paddy in water for 12 hours in a bucket or closed gunny bags submerged in water. Clean the fruit basket (box) with water. Put a layer of straw nearly 8 cm thick. Take out the grain spawn from the bottle with the help of a clean screw driver or by simply rolling the bottle vigorously on the ground

Fig. 3. Volvariella in full bloom at RCE, Bhubaneswar

with little jerk. Generally this is grain spawn (Mycelia with grain). Spray them throughout the surface of the straw in basket (box). Spray little of gram dal powder throughout. Cover with second layer of straw. Repeat upto third or fourth layer till two bottles of spawn are used. Top layer will not have spawn. It is simply a covering layer. Leave the bed for 24 hours. If it is a fruit basket hang it in a suitable place. Care may be taken that the basket does not touch the wall. If it is a box, put it on a platform keeping the lower surface open. Sprinkle 500 cc of water daily. The mushrooms will start appearing through the slits and fissures after three weeks. They can stand forty-eight hours and after watering you can safely hang in your clean drawing room. These mushrooms are not like the usual umbrella shaped (*Volvariella*), but fan shaped (Photographs 4 and 6). Their texture is harder and taste better. Entire fruit body is harvested twisting the base. The first harvest comes nearly 800 gm to 1 kg. Second and third harvest come after an interval of about 12 days. During this period water is to be sprinkled on the bed. In fact this is neither a cultivation in kitchen nor in the garden but it serves for both.

Precaution : Avoid excess of water in the bed at every stage. People may carry many pathogens for which mushrooms are susceptible. Therefore do not make an exhibition of your mushroom bed till button stage. Immediately remove any shrivilled mushroom from the bed.

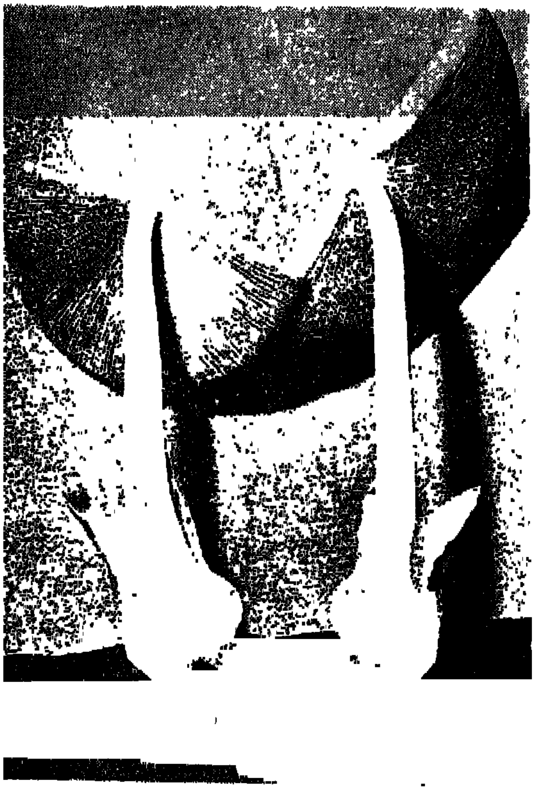

Fig 4. A paddy straw mushroom in vertical section

Eat only fresh mushroom as far as possible. If you have excess mushroom than keep them in dilute aquous solution of turmeric powder.

Fig. 6, Pleurotus in box

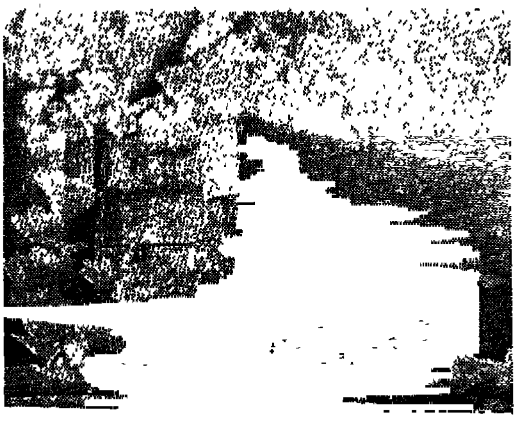

Fig 5. Pleurotus in basket

Rinse mushroom thoroughly before it is used. This kills and removes insects which enter in gills within hours.

The source for procuring spawn : Spawn is available at Solan, Coimbatore and Bhubaneswar. But the mushroom development scheme, Khandagiri Farm, Plant Protection Office (Orissa University of Agriculture and Technology) Bhubaneswar, supplies in bulk and in individual bottles at the rate of Rs. 1.50 per bottle for both the types of mushrooms discussed here.

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Evaluation of Science Curriculum : Some Instruments

UTPAL MALLIK*
Science Teaching Centre
School of Education
University of Maryland
College Park
Maryland, USA

Curriculum evaluation, in general, is a process of gathering evidence that would form the basis for the most accurate statements possible about a curriculum which is in practice. This implies that evaluation of curriculum involves collection and use of information to make decisions about an educational programme. The programme may be a set of instructional materials used nationally, the instructional activities of a single school, or the educational experiences of a single pupil. Insofar as possible, evaluation is used to understand how the course produces its effects and what parameters influence its effectiveness.

The patterns of curriculum evaluation can be characterised by the role of funding agencies for proof of results, in part by non-educationist curriculum developers who see a need for more information and knowledge about the educational process and in part by pressures from educationists themselves. The most notable characteristic of the present era of evaluation has been an attempt by several writers to formulate a conceptual framework for curriculum evaluation. Chief among these writers is, perhaps, Scriven (1967) who outlines various aspects of the methodology of evaluation to supplement philosophical and practical shortcomings of general concepts about curriculum evaluation in the following way.

The goal of evaluation activity, according to Scriven (1967), consists simply in the gathering and combining of performance data with a weighed set of goal scales to yield either comparative or numerical ratings. Logically, then, the role of evaluation is an important part of the process of curriculum development. Thus evaluation is a sub-process in the feedback chain of curriculum development.

The second clarifying point is the distinction between formative and summative evaluations. Formative evaluation is the feedback of product information into the development process for the purpose of improving the product. Summative evaluation involves the collection of data concerning an on-going programme for the purpose of making judgements about the programme. Summative data, however, may be used subsequently for formative purposes. The distinction is that certain steps must be taken to ensure that objective judgement is possible in the summative case, whereas in the formative case, pay off might well come from persons involved in product-formation.

The third important point is between pay off and intrinsic evaluation. Intrinsic evaluation involves an appraisal of the instrument itself; payoff evaluation is concerned more with effects that the instrument has—for example, the effect that a new biology programme has on the scientific literacy.

Evaluation also implies value judgement; evaluation of any kind must include procedures for the assessments of the goals themselves.

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*Presently on leave from the NCERT, New Delhi, India

So much for the philosophical background. With a great number of commercially produced and government sponsored curricular materials in almost every country, there is an increasing need for evaluating these products critically. In general terms, the criteria for judging could be (Tisher *et al.* 1972) :

- the conditions under which the programme is to be used has been specified;
- the nature of the pupils who will be using the programme is described;
- the range of contingencies and/or behaviours expected are indicated;
- criterion and other tests are developed before or during the writing of the programme;
- regular diagnosis and evaluation of pupils' progress occurs;
- vocabulary and phrases used are suitable for pupils using the programme; and
- there is integration between sections of the programme and the pupils' prior knowledge.

One very important question is how efficient is a curriculum in attaining its objectives. To answer this question it is necessary to obtain information on the achievement of the pupils. Obviously, then, the evaluation of the pupils' achievement also is another way of evaluating a curriculum. Consequently, when curricula are being evaluated and their effectiveness assessed some information about the teachers' attitudes, values and teaching practices are also pertinent.

Aspects of Science Curriculum Evaluation

1. *Uses of Science Curriculum Analysis*

Eraut *et al.* (1974 b) specify that the process of analysing instructional materials is a set of questions and techniques with the aim of elucidating and evaluating the important characteristics of a curriculum. This systematic procedure provides data for a critical judgement.

There can be varied kinds of uses of the findings of curriculum analysis. The possible uses of the analysis data are (Morrissett and Stevens 1967) :

- ✦ General Library Use—to assist readers to become acquainted with the materials in a curriculum library.
- ✦ Field Data Collection—to serve as a model for accumulating similar data from different sources of classroom use of materials.
- ✦ Decision-Making—to assist in choosing new curriculum materials.
- ✦ Curriculum Use—to help teachers understand new materials that have been selected for their use.
- ✦ Curriculum Development — to suggest curriculum developers different aspects of curriculum philosophy, construction and use so that they might think about those various aspects while developing curriculum.
- ✦ In-service Education—to introduce teachers to new ideas and approaches.
- ✦ Pre-service Education—to acquaint students with a wide range of curriculum materials through the study of analysis done by others and to introduce students to different dimensions of curriculum construction and use by having them perform curriculum analyses of their own.

Eraut and his co-workers (1974 a) go on further to suggest that curriculum material analysis data should help:

(*i*) improve implementation of new curriculum materials by providing useful information about various strengths and weaknesses of the old ones;

(*ii*) increase awareness of alternative approaches followed in different other materials;

(*iii*) increase uses of criteria for selection of fresh curriculum materials; and

(*iv*) link instructional theory with educational practice by studying promised goals and objectives of the developer of a curriculum material and the analysed data evaluating the achievements of these goals in actual practice.

2. *Functions*

The functions of the instruments designed to analyse curriculum materials can be classified in the following way :

- A descriptive-analytical function in which the materials are described and analysed according to some curriculum model.
- An evaluative function in which the materials are judged against a range of criteria.
- A decision-making function in which the purpose is to brief the decision-makers in selecting or implementing curriculum.

An analysis instrument, however, should be reasonably valid, reliable and must be easily applicable (Haussler and Pittman 1972).

3. *Systems for Analysing Curriculum Materials*

A host of curriculum material analysis instruments for science are available. The criteria for selecting them for the analysis should take into account the rationale behind a particular instrument, the type of data that are obtained by applying the instrument, the design of the instrument, an analysis of the reliability of the instrument and the like.

The function of the majority of instruments that are usually used is to provide a descriptive-analytical picture of the curriculum materials (Morrissett and Stevens 1967, Easley *et al.* 1967; Payne 1969; Haussler and Pittman 1972; and Eraut *et al.* 1974 b). Some instruments help to evaluate curriculum materials (Bond 1970; and Tyler and Klein 1971) while some others help in decision-making (Elliott 1972; *EPIE Form A 1975, and Toth 1973).

The various aspects of a curriculum material that are within the purview of different systems include :

- *Descriptive Characteristics* . Giving details of publishers, copyright, components in the material, indications about the intended users, etc.
- *Rationale and the Objectives of the Curriculum* ; Giving the rationale that the developers have put forward for the particular material.
- *Content Organisation of the Material* : Giving the sequence of units of the material.
- *Methodology Involved* : Giving information about the methodological procedures that the developers of the curriculum material prescribe for the user. More often, the developers prescribe the desired methodology in the teachers' edition.
- *Assessment of students' learning* : Giving indication of how the developers think should the students be evaluated or their learning assessed after they have gone through the material.
- *Implementation* : Indicating problems or any general comments about implementation of the material

Table 1 summarises the structures of some representative schemes. It provides a summary of emphases associated with different instruments.

Most of these require the analyst to respond to an additional list of items. The instrument of Morrissett and Stevens (1967) and of Eraut *et al.* (1974) require short essay-type answers. Most other systems consist of multiple-choice items.

The unit of instructional materials that can be analysed through the above systems varies

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*(Educational Products Information Exchange)

Table 1

X Major Emphasis *X* Minor Emphasis	Descriptive Characteristics	Rationale and objectives	Content organisation	Teaching Strategy	Learning Activities	Assessment of Students Learning	Evaluation of Programme	Implementation
Curriculum Material Analysis System; Morrissett & Stevens, 1967	X	X	X	X			X	X
A Scheme for the Analysis of Elementary Science Materials; Easley *et al.* 1967	*X*	X	*X*	X	X			
Developing Instrument for Assessing Instructional Materials; Eash, 1972		X	X	X		X	X	
A Study of Curriculum Plans; Payne, 1969	X	X	X	X	X	X	X	X
Curriculum Material Examination System; Bond, 1970		X	X	X	X	X		
Recommendations for Curriculum and Instructional Materials; Tyler & Klein, 1971		X		X			X	X
Early Childhood Curriculum Programme Analysis; Elliot, 1972	X	X	X	X	X		X	X
Instruments for Assessing Elementary Science Curriculum Projects; Toth, 1973		X	X		X	X	X	X
Sussex Scheme for the Analysis of Curriculum Materials; Eraut *et al.* 1974	X	*X*		X		X	X	X
EPIE Form A; EPIE, 1975	*X*	X	X	X		X	*X*	*X*
A Curriculum Material Analysis System for Science; Haussler & Pittman, 1972		X	X	X		*X*	X	X

from a textbook series to the individual sentences of a book. Some instruments are applied to single lessons within a textbook or programme (Easley *et al.* 1967; Haussler and Pittman 1972).

A great bulk of data generated through the use of most of the above instruments are descriptive statements about the materials (Morrissett and Stevens 1967; Payne 1969; Eash 1972; Elliot 1972; Eraut *et al.* 1974 and EPIE Form A, 1975). Only a few of these, however, produce any quantitative data. The most remarkable of those few is "A scheme for the Analysis of Elementary Science Materials" (Easley *et al.* 1967). According to this scheme, the analyst records the frequency of descriptors in the text which is summed up and ultimately a profile of the characteristics of the curricular material is obtained.

Bond (1970) would pose two kinds of questions in his instrument for each topic in the text. In the first type, the user responds by describing some aspect of the material. Through the second type of question, the analyst indicates the extent to which an aspect in the text reflects the rationale of the total curriculum. The response, numerically expressed, is numerically processed to get a quantitative picture.

The instrument of Toth (1973) also provides quantitative data where the items are organised according to their assigned numerical values. The scheme of Haussler and Pittman (1972) also provides quantitative data but it is more of 'quantity and quality' balance.

Eash's (1972) system provides yes/no response. EPIE Form A (1975) consists of multiple-choice items with some short-answer questions. The Sussex Scheme (Eraut *et al.* 1974 b) produces mainly qualitative data.

A good blending of formats which produce qualitative as well as quantitative data is the one prepared by Elliot (1972). The questionnaire consists of four parts. The first two parts help the analyst to establish his view of human intellectual development and his preference for a particular type of early childhood programming. The third part helps to determine the locally available resources. All these three parts actually help to use the fourth part which is the instrument of analysis; it consists of multiple-choice and short-answer questions.

Despite the fact that most of the instruments look very simple and straightforward, many of them really require intensive training period through which the analyst has to go. From several days to a week is required to master the techniques before they are used; especially the instruments of Haussler and Pittman (1972), Eraut *et al.* (1974), and the FPIE Form A (1975) require careful training of the analyst. The time required to complete analysis, however, depends on the scope of the instrument and the length of the unit under examination. The shortest time is taken by the system of Toth (1973) as it consists of only nine items which take 20-30 minutes. The Sussex scheme takes the longest time—up to a month plus a special training course for the analyst before he starts the analysis (Eraut *et al.* 1974). The system of Morrissett *et al.* 1971 takes a minimum of 20 manhours. The Haussler-Pitman scheme (1972) would take three hours for an average of ten instructional units.

Not much information is available on validity and reliability of the instruments described above. Many of these systems produce only qualitative data; naturally they contain a good deal of subjectivity.

In fact, a workable a reliable scheme would be the one which is a synthetic approach out of all these instruments. And a more acceptable scheme should give more quantitative data than qualitative—although in case of value judgement of a material, one cannot avoid some elements of subjectivity. In fact, there should be an in-built flexibility in the instrument which would allow wider applicability. A more workable and dependable scheme should give proper weightage to teachers' responses too (if possible, the responses of the students also).

Apart from these widely used instruments, there are many interesting studies, schemes and novel ideas related to evaluation of science curriculum. An interesting study which incorporates some of the features referred to above is by Welch (1972, I and II) on the Physical Sciences for Non-science Students (PSNS) course. He made attempts to gather information that would be useful to teachers. For example, he examined (*a*) the characteristics of students taking physical sciences, (*b*) the impact of the course on selected variables and (*c*) the effect of varying the length of the course. Welch reported various kinds of impressions that the students expressed about the courses. This type of information provides a background for the data gathered by standard research techniques.

As was mentioned earlier in this article that an evaluation instrument should be equally sensitive to students' opinions about a curriculum material. Two interesting papers, one by Doran and Sheard (1974) and the other by Hartford and Good (1976) would indicate that evaluating should be based on consideration of the course objectives, the instructional settings and the students' needs, interest and capabilities. The former authors provide analysis forms which are organised under the headings of : readability, content, presentation of material, mathematical demands, appearance, quality of illustrations and teacher aids. The technique used to evaluate textbooks, according to these authors, would be the one which would give both subjective as well as objective impressions of a textbook.

Hartford and Good (1976) use a formal operational index which is calculated for a given unit of science material or textbook with the purpose of assessment of cognitive requirements. The authors selected four topics from one of CHEM Study texts—kinetic theory of gases, chemical bonds, phase changes and equilibrium. The index is calculated by dividing the total number of instances of task performance by the total number of objectives requiring other concrete or formal operational thought. The tasks, however, represented five types of formal operational thought.

- Isolation and Control of Variables;
- Generation of All Possible Combinations;
- Understanding of Mechanical Equilibrium;
- Generation and Use of Quantified Proportions; and
- Seeing through Random Variability to Correspondences.

In the final note the authors stress the importance of assessing both the cognitive ability of students and the cognitive demands of instructional materials.

The report from the Science Education Centre, University of Oklahoma (1972) gives certain criteria which were designed to make science curriculum decisions. The instrument consists of a list of sixteen questions centered on specific goals of science education and the analysts' programme needs. The report, however, emphasises that the aim of the analyst should not be to produce numerical scores using these criteria.

Various evaluation scheme and procedures discussed above differ from each other in style, texture, taste, and purpose. But there are some questions associated with all of them which are common and very basic to most of them. Organised schemes and individual designs have been widely used mainly for two purposes : (*i*), to evaluate an on-going curriculum, and (*ii*), to select a curriculum material out of many available in the market. Some of these are opinion oriented while the others are more objective and research-based methods.

For utilisation of evaluation data for future guidance, the essential features should be (Weiss 1972) :

- Early identification of potential users of evaluation results and selection of the issues of concern to them as the major focus of study.

- Prompt completion of evaluation and early release of results.
- Involvement of administrators and programme practitioners, from both inside and outside the project, in evaluation process.
- Effective methods for presentation of findings and dissemination of information.

Any evaluation information, in order to gain serious consideration, should accompany the answers to the following questions (Stake 1972).

- Whether the evaluation is descriptive, judgemental or both;
- Whether the evaluation emphasises antecedent conditions or outcomes or both;
- Whether the evaluation is to indicate the congruence between what is intended and what occurs; and
- Whether the evaluation is intended to further the development of curricula or to help choose among available curricula.

All this would constitute what Scriven (1972) has called "Meta-Evaluation", or evaluation of evaluation. Theoretically, it involves methodological assessment of the role of evaluation. Practically, it is concerned with the evaluation of specific evaluative performances. For example, the specific assessment of "A model for analysing curriculum materials and classroom transactions" by Morrissett and his co-workers (1971) suffers from several defects; it is too committed to methodological and psychological doctrines of excessive dubiety and above all, it is excessively complicated, repititious and imprecisely described. Many of the schemes discussed here suffer from these shortcomings.

Some Suggestions in the Indian Context

In India the research organisation in the field of curriculum development at the national level can certainly play a key role in evaluating all available curriculum materials that are used throughout the country.

The most suitable scheme in the Indian context would be the one similar to the EPIE Form A with the following modifications :

- A very sincere effort has to be made to modify the instrument in a way as to critically weigh the readability of a curriculum material. This point is emphasised here because many Indian students read the textbooks which are written not in their mother tongue and often language difficulty stands on the way between the textbook and its reader. So, until we have a larger number of books written in the respective mother tongues of the students across the country, the readability of textbooks are to be constantly scrutinised. Opinions of teachers and students can be a valid guide to examine readability level.
- The proposed instrument, while in use for a textbook in one science subject, should side by side collect information about other science subjects to find out the correlation of a particular area (content) in one subject with the level of background given through other science subjects. An example would make this point clear. Structure of nucleic acids, for example, is covered in the biology textbook for secondary schools in most textbooks of the country and the NCERT textbooks as well. The authors of the biology textbook should examine, while writing the book, whether the students really have enough supporting knowledge from chemistry textbooks of purines and

pyrimidines or of hydrogen bonding or of the structure of a sugar molecule.

So, the evaluation process should try to gather information about all science subjects (and mathematics, if possible) together to find out lateral correlation between the textbooks of different subjects.

From the point of view of use of the instrument, the curriculum developers and evaluators at the national level can organise workshops, as is often done, to acquaint the personnel from the competent state agencies with the instrument. These people can go back to their respective states, collect information which are relevant to evaluation through the questionnaire and send the collected data back to the NCERT for analysis. Alternatively, the workers at the national level can collect all kinds of textbooks that are used throughout the country and analyse and evaluate them. Of course, this would not permit the opportunity to gather opinions and reactions of teachers and students about a particular material.

However, the evaluation data may be used as a library reference material in the NCERT and can be made easily available to whosoever wants to use them, either for textbook selection or to get evaluation information about an ongoing material. Such data may be profitably consulted before writing fresh curriculum materials.

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Verification of a Mathematical Problem

Jyotirmoy Hui
Boincheegram, Hooghly

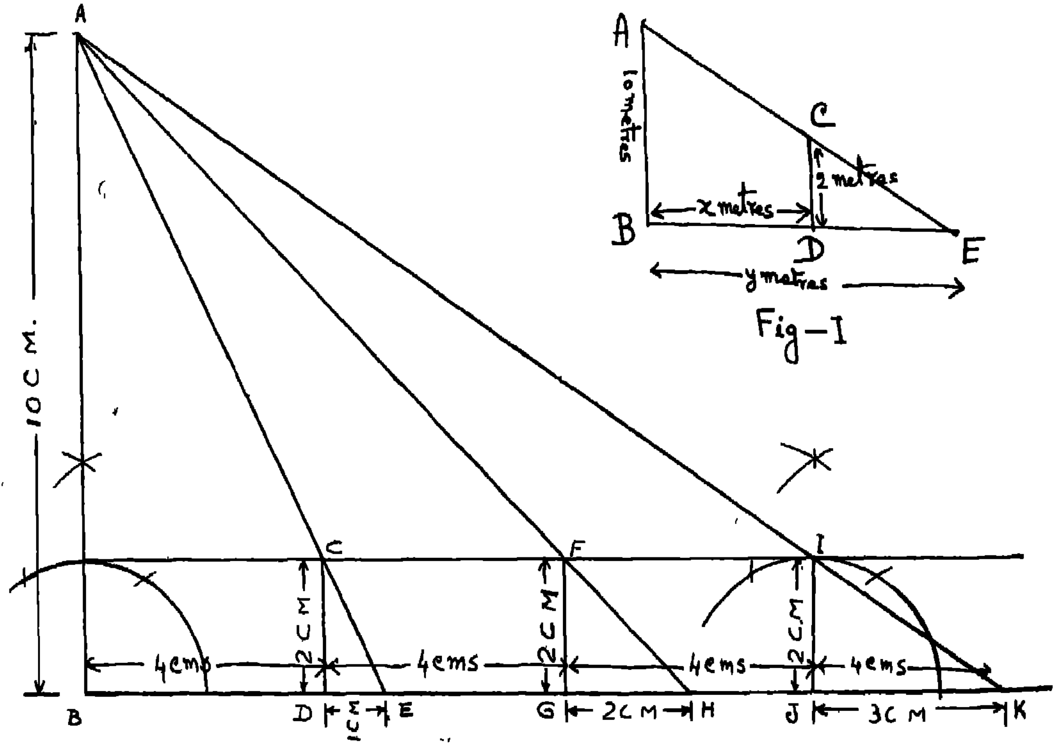
The Scope for experimental verification of mathematical problems and theories or testing their truth in laboratories is not very wide like other branches of physical science, but some mathematical problems can be verified with the help of geometry. Here, one such problem will be taken up.

Problem

A man 2 metres tall walks away from a lamp-post 10 metres high. If the man's speed be 4 metres per second, find (*i*) the speed of the farther end of the man's shadow on the pavement, (*ii*) the rate by which the man's shadow is lengthening.

Solution

Fig. 1 shows a geometrical presentation of the problem. AB=lamp-post=10 metres, CD=man=2 metres (at any instant), DE=shadow of the man. Let BD=x metres, BE=y metres. It can easily be shown that the triangles ABE and CDE are equi-angular (the lamp-post and the man being both vertical on the pavement) and as such $\frac{DE}{BE}=\frac{CD}{AB}$, that is,



Fig—I

$\frac{y-x}{y}=\frac{2}{10}=\frac{1}{5}$, which gives $y=\frac{5x}{4}$. Differentiating both sides with respect to t, we get $\frac{dy}{dt}=\frac{5}{4}\cdot\frac{dx}{dt}$, $\frac{dx}{dt}=$ the man's speed $=$ 4 metres/second. Hence, $\frac{dy}{dt}=\frac{5}{4}\cdot 4=5$ metres/second which shows that the speed of the farther end of the man's shadow is 5 metres/second.

For the second part of the problem we put $y-x=z$ (another variable) which stands for the length of the man's shadow. As before, $\frac{z}{y}=\frac{1}{5}$, or, $z=\frac{1}{5}\cdot y$, Differentiating both sides with respect to t, we get $\frac{dz}{dt}=\frac{1}{5}\cdot\frac{dy}{dt}=\frac{1}{5}\cdot 5=1$ metres/second which shows that the man's shadow is lengthening at the rate of 1 metre per second.

Verification

Now we shall verify it experimentally, that is, by proper geometrical construction we shall test the truth of the results.

For convenience of construction we change metres to centimetres. Fig. 2 shows the actual construction. AB=lamp-post (10 centimetres), CD=man (2 centimetres), BD=4 centimetres (after 1 second of journey from the base of the lamp-post).

A careful observation of Fig. 2 and accurate measurement will reveal that DE=1cm, GH=2 cms, JK=3 cms, BE=5 cms, EH=5 cms, HK=5 cms, these show that the man's shadow is lengthening at the rate of 1 cm/second (this will be 1 metre/second in the actual problem), the speed of the farther end of the man's shadow is 5 cms/second (this will be 5 metres/second in the actual problem). □

Minimum Quantity of Catalyst required to get Maximum Quality of Oxygen

Introduction

Catalyst : Catalyst is a substance, which by its presence, alters the rate of chemical reaction, without itself undergoing any chemical change. In the laboratory preparation of oxygen, manganese dioxide is used as a catalyst when oxygen is produced by heating potassium chlorate. Here manganese dioxide serves as a positive catalyst by increasing the rate of reaction. In this project, an attempt is made to study the effect of manganese dioxide on the quantitative yield of oxygen by varying the amount of catalyst used.

Procedure and Observation

Procedure : In order to study the effect of the catalyst on the quantitative yield of oxygen, a fixed quantity of potassium chlorate was heated with different quantities of manganese dioxide to see how variation in the quantity of manganese dioxide affects the yield of oxygen. A fixed quantity of 1.015 gm of potassium chlorate was heated in a hard glass test tube mixed with varying quantities of manganese dioxide ranging from 0.052 gm to 0.510 gm and the oxygen evolved was collected over a graduated jar and the volume of oxygen was measured in each case.

Summary of Observations

The quantity of Potassium Chlorate taken, the catalyst used and the volume of Oxygen evolved are tabulated in Table 1.

Observations :

Expt. No.	Weight of empty test tube (in gms)	Weight of test tube & $KClO_3$ (in gms)	Weight of Potassium Chlorate (in gms)	Weight of test tube with $KClO_3$ & MnO_2 (in gms)	Weight of MnO_2 (in gms)	Volume of Oxygen evolved (in ml)
1.	34.64	35 655	1 015	35.707	0.052	28
2	34.64	35.655	1 015	35.871	0 216	105
3.	34.64	35.655	1.015	35.985	0.330	200
4.	34.64	35.655	1.015	35.911	0.336	215
5.	34.64	35.655	0,015	36.005	0.350	220
6.	34.64	35.655	1.015	36 025	0.370	160
7.	34.64	35.655	1.015	36 125	0.470	140
8.	34 64	35 655	1.015	36.165	0.510	70

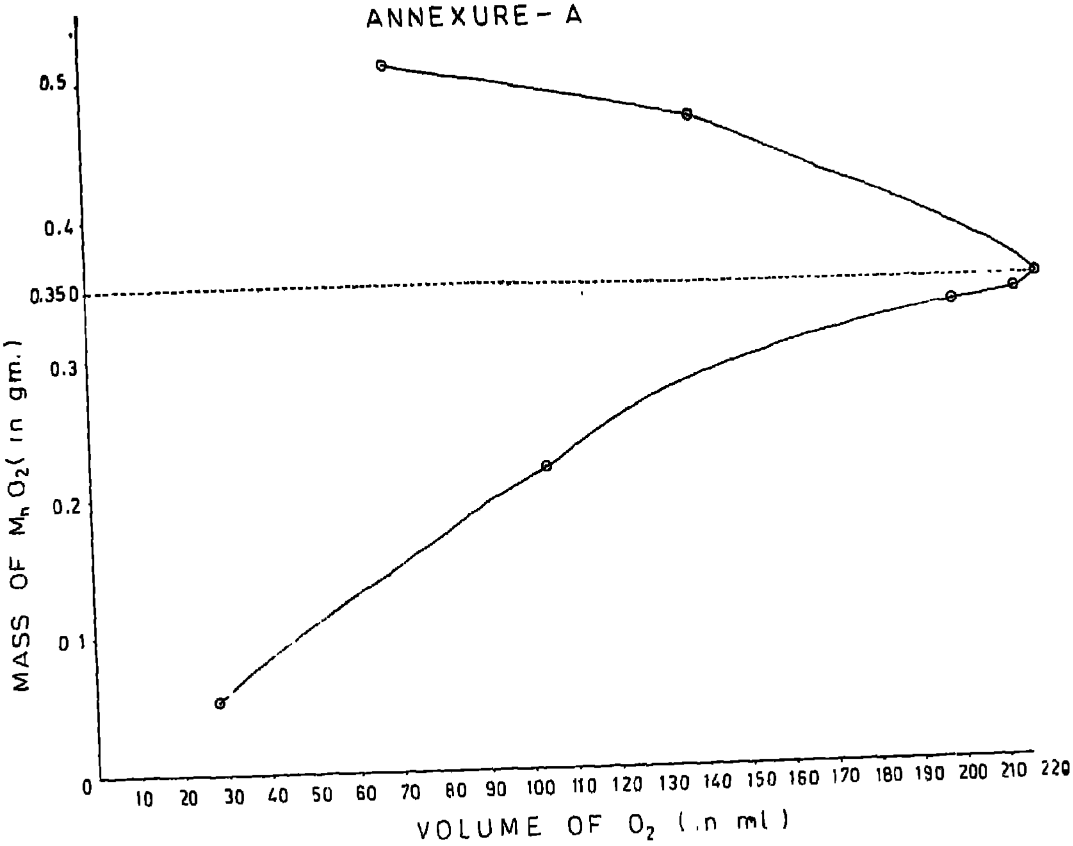


Table 1

Sl. No.	Weight of Potassium Chlorate in grams	Weight of Manganese Dioxide in grams	Volume of Oxygen in ml
1.	1.015	0.052	28
2.	1.015	0.216	105
3.	1.015	0.330	200
4.	1.015	0.336	215
5	1.015	0.350	220
6.	1 015	0.370	160
7.	1.015	0.470	140
8.	1.015	0.510	70

Conclusion

The weight of catalyst used and the volume of oxygen evolved were plotted in a graph vide Annexure 'A'. From the graph, it is seen that the volume of oxygen evolved increases from 28 ml corresponding to 52 mg of the catalyst to a maximum of 220 ml corresponding to 350 mg of the catalyst and starts falling down thereafter when the quantity of catalyst is increased above 350 mg. It is, therefore, evident that maximum yield of oxygen is obtained by using 0.35 gm of catalyst and 1.015 gm of potassium chlorate. In other words, the ratio of catalyst and potassium chlorate is 1:3 approximately for the optimum yield of oxygen.

K.A. SUBRAMANIAN (Student)
M.S. VERMA (Teacher-Supervisor)
Kendriya Vidyalaya, Bhandara (Maharashtra).
(At present in Kendriya Vidyalaya,
H.B.K., Dehra Dun)

Students' Corner

Project

Let's Play with Dyes

The art of dyeing cloth is almost as old as human civilization. Cloth removed from the Egyptian mummies of 3000 B.C. are dyed with indigo (blue) and madder (red). Ancient man used mainly 'natural dyes' (those obtained from plants, animals), and 'mineral dyes' (those from inorganic compounds). With the discovery of coal tar dyes by William Henry Perkin in 1856, there sprung up a vast industry of brilliant fast dyes obtained from coal tar, which not only produced synthetic substitutes of natural dyes such as indigo and madder (alizarin) but also threw into the shadow the art of dyeing with natural and mineral dyes. However many tribal people still use such dyes very effectively. Some traditional printing in India is done with natural dyes. So why not discover for ourselves the wonderful world of colour that abounds in the natural and mineral dyes?

What exactly is a dye? Any coloured solution is not a dye. To be a dye, the colouring matter must penetrate the fabric and deposit itself so firmly in the textile fibres that handling and washing will not remove it. To be really 'fast' the colour should not fade when exposed to light or air.

A. Dyeing with Mineral Dyes

First let us try some simple mineral colours. Here are a few recipes which are easy to follow.

1. *Black produced by ferric tannate* Put 20-40 small iron nails in a glass jar. Cover them with carbon tetrachloride or a strong solution of detergent in water. These solutions will remove the coating of oil that is normally put on these tacks to keep them from rusting, and expose the iron. Pour out the grease-dissolving solvent, rinse the nails thoroughly, and cover the nails with vinegar (or 5% acetic acid) upto a depth of 2-3 cm. Use white vinegar because the brown colour of the ordinary vinegar will interfere with your observation of the later colour changes.

Stand the glass jar containing the nails in vinegar in a pot of water, and place it over a flame to keep the water hot but not boiling. Do you see small bubbles rising which seem to come out of the nails? Can you tell why? This is because the iron is reacting with the acetic acid in the vinegar to form iron acetate. If you can procure some iron acetate you need not carry out the procedure given above, but just use an aqueous iron acetate solution.

For dyeing, soak a piece of cloth in the above solution, and wring it dry. Then dip the cloth in strong tea made by boiling tea leaves and using the liquid after straining. The iron solution which has soaked into the fibres of the cloth now reacts with the tannate ions present in tea to form a colourless salt, ferrous tannate. The latter turns to black ferric tannate as it dries in air. Thus the cloth is dyed black. Salts of lead and manganese may also be used to produce dyed cloth in a similar way.

2. *Chrome yellow :* In one glass jar dissolve 20g lead acetate in 100 ml water and in another 1g potassium bichromate in an equal amount of water. Dip a price of cotton on the first solution, remove it, wring out excess solution and dip in the second. Yellow lead chromate is pre-

cipitated into the cloth. The colour can be deepened by repeating the process.

3. *Chrome orange :* The chrome yellow can be turned into a bright orange by passing the dyed cloth quickly through a boiling solution of calcium hydroxide (slaked lime water).

4. *Iron buff :* Iron buff is rust deliberately precipitated into the textile and forms the basis for some Khaki dyes. You can produce the colour by dipping the cloth successively into the following solutions. First dip in a 2 per cent ferrous sulphate in water, followed by 5 ml conc. NH_4OH in 100 ml water, and finally 10 ml of sodium hypochlorite in 100 ml of water. The cloth should be wrung out in between the dips.

The chemistry of the process is as follows. The ammonia will convert the ferrous sulphate into grey green ferrous hydroxide. The hypochlorite in turn oxidizes this into brown ferric hydroxide, which when dry changes into the oxide producing a permanent rust colour.

5. *Prussian blue :* To obtain a beautiful Prussian blue, dip the cloth dyed with iron buff into a solution of 1g of potassium or sodium ferrocyanide and twenty drops of hydrochloric acid dissolved in 100 ml. of water. The solution is colourless but it will change the rusty colour of iron buff into a beautiful blue.

The quantities mentioned above are for small strips of material, and you will have to increase the quantity the solutions as per requirement. If heating is not involved as in the case of iron buff and prussian blue you may even attempt a simple batik pattern with it.

B. Using Natural Dyes

As I have mentioned earlier, natural dyes are those that are obtained from plant and animals you too can dye a piece of cloth, by the old method, by using as our ancestors did, various barks, nuts, roots, flowers, and leaves. For this you will need (*a*) an enamel or stainless steel pan, large enough to hold your dye solution and fabric, (*b*) a small enamel, glass or steel pan for soaking the plant material, (*c*) rubber gloves, (*d*) stirring rods (preferably glass, steel or wood), (*e*) cheesecloth or a piece of thin material torn from an old sari or dhoti, and (*f*) distilled water or rain water. The necessity of using enamel or stainless steel pans and distilled or rain water arises from the fact that presecuce of metal elements changes the colour produced by the natural dye.

The procedure for dyeing is as follows :

1. Collect the plant material required for the total amount to be dyed from one area and during the same season, as otherwise there may be slight variations in the colour of dye.

2. Chop leaves and bark finely, grind roots, or crush berries and flowers, soak overnight in enough water to cover (don't forget it should be rain water or distilled water).

3. Next morning heat the mixture slowly for an hour, adding water to replace that which boils away.

4. Strain the liquor thus obtained, through the thin cloth and add enough water to make the dye bath. If you have used 1 qt. of fresh plant material, the dye bath should be made upto 2 qt. with water. This will be enough for dyeing about 100 gm of dry fabric.

5. Let the bath cool, then immerse the damp piece of white or light coloured wool or cotton, that has previously been washed or rinsed free of starch and sizing.

6. Boil the cloth for half-an-hour or more until the desired colour is obtained stirring the material from time to time. The intensity of the colour you will get depends on the strength of the dye bath and the time that the cloth is boiled in it. Remove the cloth from the bath, rinse and dry it in the shade. The colour will become lighter as the material dries. Let the cloth almost dry then iron it smooth. If the stirring has been adequate then you should get an evenly dyed piece of material.

There are many different plants which can be used to give desired shades. These are listed in Table 1. Besides these you can always test with other material which you feel will give you a dye. When you experiment keep a note book and jot down the details of the following facts: plant used, amount used, month in which the plant was collected, results noted.

C. Mordants and Mordanting

Most natural dyes will fade and run badly when washed unless the fabric has been treated with a "mordant". The word "mordant" comes from a French word which means to 'bite'—and in a sense it does just that, letting the dye "get its teeth into" the fabric. Thus a mordant is a substance that is attracted both to the fibre to the dye, and so serves as a bonding material for getting the two together securely.

In addition to fixing dyes mordants may cause variations in shades of colours and even colour changes, e.g. red oak bark will produce a rose tan, while mordanting the wool with alum will give rise to a light brown colour.

Alum is commonly used as a mordant. The fabric is first dipped into alum solution which completely impregnates the fibres. It is then treated with a dilute alkaline solution to make the aluminium hydroxide gel. Thus the cloth holds the gel and the gel holds the dye fast and the job of producing a fast colour especially on cotton and linen is facilitated. Three common methods of mordanting are described below :

1. *Alum:* In the dyeing procedure outlined above add 100gm of alum per 100gm fabric to the strained dye solution before dyeing.

2. *Alum-cream of tartar* ($KHC_4H_4O_6$): Dissolve 450gm alum and 100gm of cream of tartar (potassium bitartrate, $KHC_4H_4O_6$) in 8 gals (36 litres) of rain/distilled water. Soak the material to be dyed for one hour in the hot fixative. Wring and dye with natural dye as described above. Remove from dye bath, wring and hang to dry in a place, away from daylight.

3. *Alum-Tannin :* Cotton is difficult to dye with natural dyes unless the cloth is mordanted with alum-tannin. For this dissolve 13 gm (½ oz) alum and (1 teaspoon) washing soda (sodium carbonate) in 2 quarts of rain/distilled water and divide into two parts. Wet the cloth to be dyed thoroughly in water, squeeze out excess water and then immerse in the alum solution. Bring the solution to a boil gradually and continue boiling for an hour. Allow to stand overnight. Next morning, squeeze out the excess solution, rinse in rain/distilled water, and then put the material in a tannin solution (strong tea as mentioned earlier is ideal). Wring it out and mordant the cotton in the second alum bath just as before. Leave the cloth in the mordant till you are ready to dye squeeze out the liquid, rinse in rain/distilled water, and then wring again. Then place the cotton in the dye bath and bring to boil, sterring occasionally to get even dyeing. Wring out and hang up to dry in a shade.

SHAKUNTALA BHATTACHARYA
Department of Education
in Science and Mathematics
NCERT, New Delhi

Students' Corner

How Good are You in Science ?

How good are you in Science has been introduced as a regular feature. You can use it for fun or prepare yourself for a test. Score the answers and check up with the given key.

1. The radiations from radioactive materials which are deflected in a magnetic field are
   (a) α and β
   (b) α and γ
   (c) β and γ
   (d) α, β and γ
   (e) none of the above
2. The loss of a neutron from each of the atoms of a substance
   (a) changes the chemical nature of the substance
   (b) changes the physical properties of the substance
   (c) changes the charge of the atoms
   (d) reduces the atomic number of the atoms
   (e) causes the loss of electrons from the atoms
3. Life is relatively scarce in the deepest layers of the oceans mainly because of
   (a) low temperatures
   (b) abscence of light
   (c) high pressures
   (d) lack of food
   (e) swift currents
4. In an atmosphere consisting only of methane, ammonia, carbon dioxide, hydrogen and nitrogen most chemicals would
   (a) be oxidised
   (b) be reduced
   (c) be ionized
   (d) be polymerised
   (e) be radioactive
5. Of the following, the most recently evolved were
   (a) cone-bearing plants
   (b) mosses
   (c) flowering plants
   (d) ferns
   (e) liverworts
6. Members of the following pair of vertebrates are closely related, one giving rise directly to the other
   (a) fishes and reptiles
   (b) reptiles and birds
   (c) mammals and birds
   (d) amphibia and mammals
   (e) amphibia and birds
7. There are few shrubs on the floor of a tropical rain forest mainly because it is too
   (a) dark
   (b) moist
   (c) fluctuating in temperature
   (d) overgrown with herbs
   (e) densely populated by grazing animals
8. Mitosis involves
   (a) a random separation of chromosomes
   (b) transverse splitting of chromosomes
   (c) sudden change in the genes
   (d) a strictly conterolled separation of chromatides

(e) a production of unlike daughter nuclei

9. The origin of new species is promoted by
   (a) crowding
   (b) populations of large size
   (c) under population
   (d) geographic isolation
   (e) none of the above

10. A shock absorber on a car causes road shocks to be reduced because each shock
   (a) is transmitted in all directions through oil
   (b) is transferred to the springs
   (c) is abosrbed more slowly
   (d) is absorbed more quickly
   (e) is received by the shock absorber only and not the body

11. When the speed of a car is doubled, its kinetic energy
   (a) remains the same
   (b) is two times as great
   (c) is twice as great
   (d) is four times as great
   (e) is increased in proportion to the acceleration

12. The main phenomenon producing a rainbow are
   (a) reflection, refraction and diffraction
   (b) refraction and dispersion
   (c) dispersion
   (d) reflection and dispersion
   (e) reflection, refraction and dispersion

13. In a crystal radio receiver, the crystal functions as a
   (a) capacitor
   (b) conductor
   (c) amplifier
   (d) oscillator
   (e) rectifier

14. Bakelite, as a plastic, can be classified an a
   (a) co-polymer
   (b) thermosetting plastic
   (c) thermosoftening plaste
   (d) a & b
   (e) a & c

15. It is difficult to extract aluminium from its ore in a blast furnace because aluminium
   (a) has a high melting point
   (b) burns readily
   (c) is protected by its oxide layer
   (d) has a low density
   (e) ores are mixed with impurities

16. Alloys can be
   (a) solid solutions of one metal in another
   (b) mixtures of mettalic crystals
   (c) mixtures of metals and mettalic compounds
   (d) a and b
   (e) a, b and c

17. If two objects A and B have the same momentum, B can have more kinetic energy than A only if it
   (a) weights more than A
   (b) weights the same as A
   (c) is moving faster than A
   (d) is moving more slowly than A
   (e) occupies a higher position than A

18. During the Middle Ages, theories about the universe were based mainly on the ideas of
   (a) Newton
   (b) Harvey
   (c) Kepler
   (d) Aristotle
   (e) Copernicus

19. Dalton postulated the atomic theory in order to explain
   (a) the nature of matter
   (b) the nature of the atom
   (c) the laws of chemical combustion
   (d) the differences between solids, liquids and gases
   (e) the difference between elements, compounds and mixtures

20. One effective means of combating soil erosion on hill would be to
    - (a) plough parallel furrows down the slope of the hill
    - (b) plough around the contours of the hill
    - (c) graze sheep on the hill
    - (d) add trace elements to the soil
    - (e) clear trees from the hill

21. Some chemicals are usually known by common names can you match the common names (Columns A) with their chemical names (Column B)

Coloumn-A

(a) Bleaching powder
(b) Baking soda
(c) Baryta
(d) Blue vitriol
(e) Black lead
(f) Brimstone
(g) Borax
(h) Chalk
(i) Carbolic acid
(j) Calomel
(k) Chile saltpetre
(l) Cream of Tartar
(m) Chrome alum
(n) Epsom salts
(o) Milk of magnesia
(p) Plaster of Paris
(q) Hypo
(r) Prussic acid
(s) Red lead
(t) Quick silver
(u) Talc
(v) Water glass
(w) Silica
(x) Saltpetre
(y) Sal ammoniac
(z) Whiting

Coloumn-B

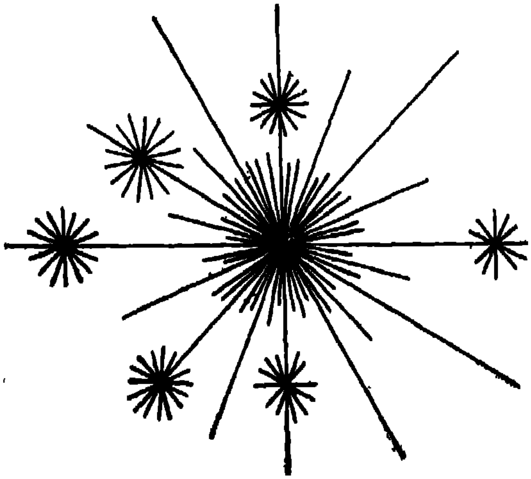
(1) Mercurous chloride
(2) Barium oxide
(3) Magnesium hydroxide in water
(4) Ammonium chloride
(5) Calcium carbonate
(6) Calcium hypochlorite
(7) Chromium potassium sulphate
(8) Calcium sulphate
(9) Copper sulphate
(10) Sodium bicarbonate
(11) Lead tetroxide
(12) Potassium bitartrate
(13) Graphite (mineral carbon)
(14) Mercury
(15) Magnesium silicate
(16) Hydrocyanic acid
(17) Phenol
(18) Sodium nitrate
(19) Magnesium sulphate
(20) Sodium silicate
(21) Silicon dioxide
(22) Powdered calcium carbonate
(23) Sodium thiosulfate
(24) Sodium borate
(25) Sulphur
(26) Potassium nitrate

22. Name the scientist associated with the following scientific discoveries and theories
    - (a) Laws of motion
    - (b) Circulation of blood
    - (c) Theory of natural selection
    - (d) Classification of plants
    - (e) Uranium gives off invisible 'radiation'
    - (f) Principle of the pendulum
    - (g) Periodicity of elements
    - (h) Wave theory of light.

SHAKUNTALA BHATTACHARYA
NCERT
New Delhi

(Answers on page 41)

Science News



Device to Help the Blind

A hand-held aid, which employs ultrasonic sensing and auditory perception, has been developed by the National Physical Laboratory in New Delhi. The ultrasonic device, recently developed by Indian scientists, will enable a blind person to clearly distinguish between a door and a wall. The device will also help the blind to detect the presence of an obstacle and to gauge its distance from the pitch of the signals received by it. The device can give the following other information forward or backward motion of obstacles, detection of narrow obstacles like poles and roads, detection of grass and bushes, location of fallen objects and detection of the edge of a beach or a pond.

The device sends an ultrasonic beam of sweeping frequency that bounces back due to reflection when an obstacle is met. The received echo is mixed with a portion of the transmitted signal, and the resulting difference frequency signal is conveyed to the user through earphones.

For reflection from a stationary object, the best note is constant and proportional to the range of the reflecting object. An idea of the distance of the obstacle can thus be had through variations in the pitch of the sound. The reflecting property of the object affects the tone heard in the earphones, and some information about the reflecting surface can also be gathered.

The device can be operated by putting the switches on and listening through the earphones. If no obstacle is present, a hissing sound—similar to that which comes when switching on a radio—is heard.

The device is normally held horizontally in the hand and the scanning is done by providing side ways motion. For ground level obstacle detection, it has to be tilted downwards.

New Drug for Rheumatism

The Regional Research Laboratory, Jammu has developed a drug for the treatment of rheumatism and rheumatoid arthritis. The drug, Salai Guggal, is prepared from the tree, Salai, (*Boswellia serratta*) which is found in abundance in Madhya Pradesh and Gujarat. Dr. C.K. Atal, Director of the laboratory, states.

Dr. Atal said scientists from the department of pharmacology who had worked on medical plants have demonstrated the beneficial effects of the de-fatted preparation of Salai Guggal. After trying the drug for three years on animals, collaboration was sought with the Government Medical College, Jammu to test it on human volunteers. "It is noteworthy to mention that 20 per cent resistant cases of rheumatoid arthritis, who had undergone treatment at various centres, agreed to subject themselves to this study. Our preliminary assessment had revealed excellent to good results in all these cases without any toxic or adverse side effects" he added.

BCG—No Immunity from Lung TB

The Indian Council of Medical Research said a large scale trial revealed that the BCG (Bacillus Calmette and Guerin) vaccine did not provide immunity against tuberculosis of the lung.

ICMR said that the BCG, over a seven and half year trial, "did not show any protection against the development of pulmonary (lung) tuberculosis". The trial was conducted at Chingleput in Tamil Nadu during 1971-78 in collaboration with the World Health Organization. ICMR, which made known the trial findings some months ago, on Monday published the complete report of the study. However, it warned that the study should not be extended to infants "single infant tuberculosis was not observed in the trial".

The world's biggest BCG trial involved a population of 360,000 and it was carried out using two best strains of the BCG vaccine, ICMR said. Two-thirds of the population received the vaccine in 1971. They were observed for seven and half years along with the remaining unvaccinated persons who were used as "control group". The number of new cases of lung tuberculosis was in fact, found to be higher among the vaccinated group than in the control group indicating the inefficacy of BCG vaccination.

Particle is Puzzling Physicists

Research scholars in the University of California say they are planning to test their surprising discovery that a sub-atomic particle called neutrino seems able to continually change its form.

If the particle does have the ability to change constantly from one type of neutrino to another it may have a major impact on the world of physics. It will mean that the neutrino-long thought to be an elusive packet of energy without substance—must have at least a little weight. The laws of physics do not permit a massless particle to change from form to form.

Mr. Frederick Reines of the university, co-discoverer of the neutrino in 1956 described his group's findings during a scientific conference in Washington, D.C. The neutrino is a peculiar little particle that comes in at least three distinct varieties, plus an anti-matter counterpart for each type. It has no electric charge.

Since almost countless neutrinos are moving around in space, if the particles have any mass at all: 'you might double the total mass of the universe' says physicist Mr. Henry Sobel. But we don't really know how much mass it adds since we don't know the mass of the 'neutrino' he added. That refuels speculation whether the universe, which is believed to have been expanding for about 15 billion years is so heavy that its own gravity will someday reverse the process and cause it to collapse in a fiery cataclysm billions of years from now. It may also explain why other investigators have found barely a third of the neutrinos that should be streaming to earth from the nuclear reactions believed to power the sun. If many of the neutrinos changed into some other variety the investigators never had a chance to pot them.

The missing neutrinos led some physicists to wonder if they really understand what is happening in the sun. Others suggest that the sun's power is winding down and the sun itself is cooling off. "If neutrinos change state on their way to the earth. Sobel then that could explain these differences," Mr. Sobel said.

The Earth Wore a Ring

Thirtyfour million years ago the earth may have been surrounded by a ring of debris similar to the rings that circle Saturn, according to a space agency scientist. Dr. John A. O'Keefe calculates that the ring composed of tektites, which are glass meteorities, lasted several million years and that its shadow caused dramatic climate changes in our planet's northern hemisphere. Dr. O'Keefe's theory could explain a sudden temperature change four million years ago that geologists call the eocene event. This change is considered to be the most profound climatic event in the entire tertiary period between two and 65 million years ago.

The eocene era represents the early part of the tertiary period in earth's geological history. Through botanical studies, scientists have learnt that the temperature changes occurred at the end of the eocene, but until now there has been no acceptable explanation for them.

Human Minds out of Computers

Computers are being taught to give expert medical advice, decide court cases and think the way people do, and some day may even surpass even the best human minds, according to scientists. The newest computer programmes attempt to get computers to handle complex concepts rather than just numbers said Dr. Edward Shortliffe, one of the 1,000 scientists attending the first national conference on artificial intelligence at Stanford University this week.

But Dr. Shortliffe, a Stanford physician who is devising a programme to help doctors treat cancer said he doubted that these "expert" computer programmes would replace human experts any time soon, "Because when it comes to common sense, computers are really not very good", he said. Projects discussed at the week long conference, which ended on Thursday, included a programme to determine blame and damage awards if a manufacturer's prodcut caused injury.

Another system from the University of Pitsburgh helps doctor diagnose diseases. It is scheduled for actual trials later this year. Nevertheless, scientists say they are still baffled at how to give computers "common sense". "We don't understand our own minds" said Professor John Mc Carthy of Stanford, a pioneer in the field, "If we could do adequate self-observation, may be artificial intelligence would be easy, but then a lot of things would be easier".

Instrument to Find Man's Tastes

Soviet students have succeeded in developing an electric taste meter which can tell the slightest deviations in man's normal tastes. Students at the Riga Medical Institute have carried out an experiment through application of an electrode to various parts of the tongue as a scale on the taste meter shows the degree of irritation of the receptors.

The instrument will be of use to doctors as a simple and convenient auxiliary means of diagnosing some diseases of the central and peripheral nervous system.

Eclipse Effect on Animals

The study, conducted into 33 species of animals, including birds has revealed that all the litters born during the eclipse were perfectly normal, healthy, with no congenital defects or malformations. Two Nilgai and three cheetal fauns along with litters of guinea pigs and hares born during the study are perfectly well with normal developmental milestones.

A three-month study conducted by the Wild Life Department of Rajasthan, into the behavioural pattern of animals and birds during the solar eclipse on February 16, has repudiated the popular belief that congenital deforms take place in pregnant mothers.

Parhia kites and vultures were soaring high in the sky before the eclipse was set in. These birds came down and circled at lower levels during the peak eclipse time and gained the previous height after the eclipse ended. Parakeets and, water birds also behaved in the same manner during peak eclipse time as if they were preparing for approaching evening and immediately after the culmination of eclipse behaved in way normal.

Partial solar eclipse din't effect the feeding habits of wild animals and birds. With routine food distribution among animals, two pairs of and each species were given food before, during after the eclipse. All the animals fed themselves to their satisfaction irrespective of eclipse. They enjoyed their food even during eclipse time, the study said.

Anti-Tumor Substance

The three-man team, led by Dr. Brian McAuslan of the Australian Commonwealth Scientific and Industrial Research Organization's Molecular and Cellular Biology Unit in Sydney has identified a substance which they believe regulates the growth of blood vessels and is a major factor in the development of tumours, particularly cancer growth. The substance as ionic, or non-metallic, copper. Dr. McAuslan said the discovery represented a breakthrough in bio-medical research. Many groups around the world, particularly in the United States and Britain, had been trying to identify this so-called angiogenic factor for many years.

It had been known that tumours released this factor, which induced new blood vessels to grow and tumours to increase in size. But until now, no one had been successful in isolating it. It was important because without a supply of blood vessels, a tumour could not grow.

He said the discovery could have implications for treating certain cancer tumours as it could be possible to suppress the effect of the ionic copper and so at least temporarily stop the growth of some tumours. He said the factor in small amounts was also important in the repair of blood vessels and healing.

The team has established ionic copper as the angiogenic factor by a number of complex as says in which they have shown that cultured endothelial cells (those which form the internal surfaces of blood vessels) migrate towards a source of ionic copper. For instance, if an area of the body which normally has no blood vessels, such as the anterior, of the eye chamber of a rat , is impregnated with ionic copper, numerous blood vessels grow into the region within days.

The researchers are now trying to establish where the tumours acquire ionic copper from in the first place. It is known that there is a naturally-occurring, copper-containing protein in the blood, known as ceruloplasmin, which they have shown could be the source. "We have isolated a fraction of ceruloplasmin which not only enhances the movement of endothelial cells in test tubes but also induces the development of blood vessels in living organisms," said Dr. McAuslan. They have also found that a number of salicylates, such as aspirin, have a similar angiogenic action to ionic copper. He said the discovery could also raise questions about the safety of copper intrauterine devices (IUDS).

A victorian research team led by Dr. Michael Briggs of Deakin University, Geelong, had already discovered that the copper used in some IUDS mixed with fats in the uterus to form a cancer causing samples of mucous taken from the cervical canal of some women using copper IUDS.

Mango Tree—Indicator of Air Pollution

Mango trees and sunflower plants have been found to be extremely useful for assessing air pollution in Bombay city, according to the findings of a research project sponsored by the University Grants Commission on "effects of industrial air pollutants on plants". The research was conducted by Dr. S. B. Chaphekar, associate professor in ecology in the Institute of Sciences, Bombay. He was successful in preparing maps showing the distribution of air pollution in Bombay city, with the help of mango leaves and commelina, a common roadside weed.

Laboratory experiments carried out with controlled fumigation of plants by sulphur dioxide have also shown that 10-day old plants of 'math' (amaranthus viridis) are highly sensitive and have a very good potential to monitor the pollution caused by sulphur dioxide which is the most extensively emitted gas by industrial processes.

Sulphur dioxide which causes respiratory diseases, constitutes more than one-third of the nearly 1000 tons of pollutants that are shrown up into the atmosphere daily by industries in Greater Bombay region. One of the other pollutants is ammonia. Experiments by Dr. Chaphekar have shown that 'gaur' (cyamopsis tetragonoloba and hemp (crotalaria juncea) are suitable for detecting ammonia in air.

Cholanaikans, the cavemen of Kerala whose very existence came to light only a few years ago, face extinction. And all because "civilization" came to them.

Dr. P. R. G. Mathur, Director of Kerala's Institute of Research, Training and Development Studies of Scheduled Castes and Tribes, says that there are only 300 of them now, and if, the present birth and death rates among them continue, there would be none of them left in 10 to 15 years.

During 1977-79 there were only eight births in the tribal community living along the Chaliyar banks in the remote Karulai range reserve forest in Wynad. During the same period there were 24 deaths, including five of the new born.

Publicity about the finding of cavemen in the mid-70s attracted many curious visitors to the Cholanaikans' 'ala' (cave) dwellings. Among the visitors were research scholars, photographers, foreign anthropologists. One of the legacies of these visits has been the spread of syphilis, which has affected a third of the surviving Cholanaikans, malnutrition, anaemia, scabies and diarrohoea are the other common ailments found among these tribals. And they are reluctant to get themselves treated.

Dearth of girls of marriageable age is another factor which is hastening the process of their extinction. Not long ago, a non-tribal married a Cholanaikan girl; after giving birth to a child, she committed suicide.

Dr. Mathur feels that unless the government declares the forest range occupied by the Cholanaikens a 'protected area' and restricts entry of non-tribals, they will be further exposed to the outside world and all its attendant dangers. His institute held a 'medical camp' in the area last month. Blood tests confirmed the widespread prevalence of syphilis and it was decided to give pencillin treatment to the entire community.

Ancient Idols Found

Idols estimated to be over 2,100 years old have been found at Pachala village, 17 km from Sawaimadhopur (Rajasthan).

Dr. Ratenchandra Aggarwal, Director of Archaeology and Museums said that the discovery had inspired the department to look for more such antiques along the banks of the Gambhir, Morel, Banas and Chambal rivers.

He also said that stone age weapons were recently unearthed at a place 12 km from Karauli and for the first time, eight copper axes were found in Kota village in the district of Sawaimadhopur. The axes bear a great similarity with those found along the banks of the Ganga and the Jamuna.

Unique Cloud Formation on Mars

New photographs taken of Mars show an unusual type of weather pattern that scientists have not seen on the planet before, the National Aeronautics and Space Administration said yesterday, reports AP.

NASA scientists said a mosaic of 102 photographs, taken by the Viking orbiter 1 satellite in late February, showed a distinct weather front or an atmospheric shock wave.

"Nothing like this weather phenomenon has ever been seen before on Mars", said a NASA spokesman. Agency officials said such observances on Mars could help scientists understand the causes of weather on earth.

A NASA statement said the photograph show a sharp dark line of clouds and weather activity near the huge valcano Arsia Mons in the Tharsis ridge of the planet. It said the photographs also show four small clouds that hover very closely together at an altitude of about 25 km near the Lowell Crater.

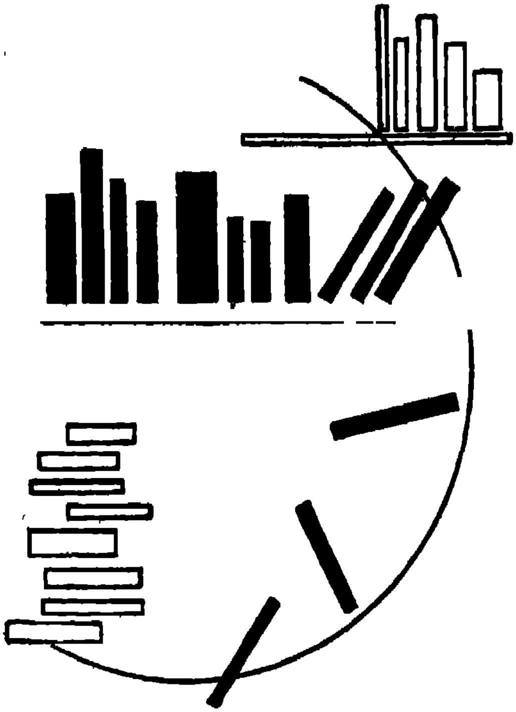
"Distinct cloud pattern shadows are rarely apparent on the face of Mars", the spokesman said.

The satellite was launched on August 20 1975, and entered the orbit of Mars on June 19 1976. It continue to transmit an average of 30 photographs a day.

Answers

1. (a) 2. (b), 3. (b), 4. (b), 5. (c), 6. (b), 7. (a), 8. (d), 9. (d), 10. (c), 11. (d), 12. (e), 13. (e), 14. (d), 15. (b), 16. (e), 17. (d), 18. (d), 19. (c), 20 (b), 21(a). (6), (b). (10), (c). (2), (d). (9), (e). (13), (f). (25), (g). (24), (h). (5), (i). (17), (j). (1), (k). (18), (l). (12), (m). (7), (n). (19), (o). (3), (p). (8), (q). (23), (r). (16), (s). (11), (t). (14), (u). (15), (v). (20), (w). (21), (x). (26), (y). (2), (z). (22). 22(a). Newton, (b). Harvey, (c). Darwing, (d). Linnaeus, (e). Baquerel, (f). Galileo, (g). Mendeleef, (h). Huygens.

Book Review



Modern Biology

Robert Barrass, W. H. Allen, London, 1979, *xiii, pp.* 304, *illus.* £ 2.25.

In recent years, the science of biology has made some remarkable advance in unravelling many basic mysteries of the life processes. One of the most significant contributing factor for this phenomenal progress has been an integrated and interdisciplinary approach, discarding the customary distinction between botany, zoology, etc. In this context, the book under review is a welcome addition to introductory biology for its unified, basic coverage of the subject.

The book falls into four parts, sub-divided into several chapters. Each chapter provides an effective background to its subject and several test questions have been included at the end of each chapter. The first part includes eight chapters which deal with diversity of life and adaptations of various organisms from bacteria to mammals. The author has described , in simple language, the various forms of microbial, plant and animal life and their basic structural organizations. The growth processes which occur in different types of organisms and their modes of life have been lucidly explained with suitable illustrations. The examples are well chosen so as to include organisms the people are most familiar with.

The second part of the book considers the various types of plant and animal nutritions, beginning with photosynthesis and giving an account of mechanisms involved in nutrient uptake. This part has also several chapters on interdependence of different forms of life, social behaviour and community living of the organisms. One of the most significant chapter of this part, in present reviewer's opinion, is the last chapter, where the author has discussed the population growth and various factors associated with it like, pollution, conservation etc. Mr. Barrass has done well to include this topic because of the increasing, current awareness on population explosion and its impact on the ecosystem.

The third part of the book consists of the chapters describing the cell and tissue systems and various metabolic processes which take place at the organizational level. Here, the author has endeavoured, successfully, through the selective marshalling of facts, the exposition of principles related to movements, transport gaseous exchanges, sensory systems, etc. Several simple experiments have been described for a clearer understanding of the physiological processes involved in the above mentioned systems.

The last section, comprising of three chapters, is concerned with reproduction, heredity and the origin of life. In this part, the author has also discussed about the population control which is very much a relevant topic in modern biology.

One of the most useful features of this book is its appendices where important hints regarding the preparation for examination, suggested further readings and a glossary have been included. The book covers a lot of ground and in doing so, a few important topics have been dealt rather briefly. But apart from this minor blemish it accomplishes its objective quite well. The book is well designed with many labelled diagrams and attractive format. As an introdutory book on modern biology it is one of the better of its kind.

S. CHATTERJEE
School of Life Sciences
Jawaharlal Nehru University
New Delhi

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Science Movement Through Exhibitions

A. K. JALALUDDIN
D.E.S.M.
NCERT, New Delhi

Science exhibitions, held annually at the national, state and sub-regional levels under the grants-in-aid of the Jawaharlal Nehru Memorial Fund and the supervision of the NCERT, have been largely successful in creating enthusiasm among the school children, particularly in the urban areas to participate in out-of-school activities in science in a big way. However, in the absence of an integrated approach to link up these exhibitions with other continuing forms of out-of-school activities in science, the enthusiasm of the children generated in the process could not be utilized to develop a meaningful movement in the country to promote scoailly relevant scientific ideas. Hence, the need for reformulation of the objectives of science exhibitions and establishment of an operational set-up for their achievement.

THR BROAD aims of Science Exhibitions, like the Science club or Science Museum Movements, should be to improve social relevancy of science education by way of relating science to society, "*socializing*" the school on one hand and "*educationalizing*" the society on the other. More specifically, the objectives should be (1) to emphasize the role of science education as a part of the general education for citizenship; (2) to make the younger generation keen observers of their natural and social environment and to help them correlate their knowledge in science with their environment; (3) to make the young students appreciate the nature and methods of science and to develop the spirit of enquiry and self-learning; (4) to make the young students develop a sense of responsibility to the community and also learn from the community its problems and needs; (5) to offer an opportuntiy to the potential scientists from the younger generation to display their talent in science; (6) to offer an opportunity to the young people to interact with scientists and specialists in various fields to widen their areas of interest and increase their knowledge of the scope of various trades and professions; (7) to make the science exhibitions serve as source for acquisition of exhibits for establishment and proliferation of permanent, semi-permanent and mobile science education museums at micro-and macro-levels; and (8) to ultimately make the schools develop into centres for promotion of social change.

Implementation

One of the basic requirements for the implementation of the above objectives is to promote Science Club, Science Museums, Nature Conservation Programmes and other out-of-school activities along with the science fair movement on one hand and linking of all these activities with the non-formal and adult education programmes on the other. The linkage could be established by involving representatives of the existing agencies in the above programmes in the apical, regional and sub-regional advisory bodies or working groups.

The policy of funding science exhibitisions should be appropriately designed to promote the exhibitions as a part of the above integrated approach. Preparation for a science exhibition should not be taken as an isolated activity. A grant sanctioned for a region should be essentially utilised for the generation of local resources and funds so that such grants could be diverted subsequently to other areas which need such assistance.

The dimension and scope of the programme call for adequate and consistent coverage by the mass media, both public and private. It is quite likely that many of the national and regional dailies, weeklies and other periodicals would be willing to cover the out-of-school activities in science in their children's pages as it is done in many other countries.

The actual implementation of the programme should be entrusted to an institution having wide interest in the development of school curriculum in science and all forms of out-of-school activities in science, science talent search and science museums and which is prepared to offer its facilities and full time services of a group of specialists in the field for the implementation of the programme. From these considerations, the NCERT appears to be the appropriate body for the above purpose. However, to link the science club movement, establishment of science museums, science talent search, etc. with the science exhibition movement on a permanent basis and coordinate them with other agencies, it would be necessary to set up a permanent Cell in the Department of Education in Science and Mathematics to deal with out-of-school activities in science.

The Implementation Cell

The Cell should consist of five subject specialists, in physics, chemistry, botany, zoology and mathematics, and should be headed by a Reader having experience in the field. For this purpose, the post of Reader (Exhibition) created in the NCERT in 1977 should be revived and a suitable person appointed as early as possible.

The Cell should function under an Advisory Board (separate from the Departmental Advisory Board) headed by the Dean (Coordination) or the Head of the Department of DESM. This Board should include representatives of the well-known Science Centres (like Sarabhai Science Centre, Ahmedabad); Science Museums (like Birla Science and Technological Museum, Calcutta; Visveswaraya Museum, Bangalore); Science Talent Schemes (like the National Talent Search, NCERT; J. C. Bose Science Talent Search, Calcutta; Junior Science Talent Search, Delhi Administration); College Science Improvement Programme (COSIP); University Leadership Programme (ULP); The National Research Development Corporation (NRDC); popular science journals (like School Science, NCERT; Science Today, Bombay; etc.) ; All India Science Teachers' Association (AISTA); Science Writer's Association, etc

The specific functions of the Cell would be (1) to develop methods and materials for promotion of out-of-school activities in science; (2) to generate ideas for meaningful projects for children in science; (3) to inspire leading scientific institutions, universities, learned societies and individual scientists and specialists to come forward with such ideas and liaise with them; (4) to act as a clearing house of such ideas and institutionalize the procedure for their dissemination throughout the country, particularly to the rural and remote areas; (5) to organise seminars, workshops and orientation programmes for the state and institutional personnel associated with the programme; (6) to assist the appropriate authorities in science talent search and setting up of science museums through this programme; (7) to liaise with the International Coordinating Committee for the Presentation of Science and the Development of Out-of-school Activities (ICC), Brussels and Unesco, Paris for exchange of ideas with other countries; (8) to assist concerned authorities in the implementation of programmes in non-formal and adult education through promotion of socially relevant scientific ideas and projects; (9) to liaise with the radio, television and press for popularising the movement; (10) to involve eminent personalities in the fields of science, agriculture, industry, medicine and other developmental and welfare programmes so that they take interest in the movement and help in the evaluation of the projects and exhibits.

The Nature of Projects

The Implementation Cell should initially concentrate on evolving an approach for identification of a list of possible projects in conformity with the broad objectives mentioned earlier. Adequate care should be taken to see that such projects serve as an activity complementary both to the students' school programmes including "work experience (socially useful productive work)" and to the wider programmes of community education. Work on such projects should spread over one academic year and it should infuse among the participating students an urge towards self-learning. The children should also be encouraged to interact with the members of the community and to consult specialists in the appropriate fields to acquire relevant information to perceive the dimensions of a problem and the methods of tackling it. The Implementation Cell should facilitate such contacts.

The following are two sample projects :

Illustrative Project I

Optimization of the Use of Batteries in School Laboratories in areas not covered by Commercial Supply of Electricity.

SALIENT POINTS

A. The Problem

1. Survey of the type of experiments done in schools which require power sources;
2. Survey of the type of batteries used with detailed study of their specification;
3. Survey of the frequency and duration of use of each item;
4. Study of possible wastage due to improper use, non-use and poor maintenance;
5. Survey of average capital investment and recurring expenditure.

B. Technical Study of the Problem

1. Cost-effectiveness analysis of the different types of cells in terms of ampere-hours per rupee, voltage and current-wise matching with experiments, etc.
2. Wastage due to inappropriate circuit design in the experiments and non-judicious selection of components like resistances, short circuiting, etc.
3. Problems of maintenance, like humidity, continuous instead of intermittent use etc.

C. Investigation of Remedial Measures

1. Selection of most appropriate set of cells for a given course at minimum cost (combining capital and recurring costs).
2. Scope of using :
   (*i*) rechargeable cells
   (*ii*) small cycle dynamos
   (*iii*) solar cells
   (*iv*) any other device
   and analysis of the comparative cost-effectiveness of these devices.
3. Development of new circuit designs and safety devices and procedures to reduce wastage while in use.
4. Development of improved methods for preservation of the cells when they are not in use.

D. Preparation of (*i*) project report, charts, devices and demonstration kits for exhibition; (*ii*) a small write-up for evalnation of the project and dissemination.

Illustrative Project II

Parthenium, the 'new' weed

SALIENT POINTS

A. *The Problem*

1. How does one identify the weed?
2. Where does the weed grow?
3. How harmful is it to (*a*) cultivated plants and/or to (*b*) man and other animals?
4. Is it really a 'new' weed or it used to grow earlier in our country?
5. People say it has come from the Americas (New World). Is this true?
6. Does it really grow in the New World?
7. How do the people in the New World fight it if it really grows there?
8. If it really is a New World plant, how has it migrated over such a great distance despite geographical isolation?
9. Is it a seasonal plant or a perennial plant?
10. In which season does it grow most in our country if it is a seasonal plant?
11. What are the local practices in different regions of the neighbourhood to eradicate the plant?
12. How conscious are people in the neighbourhood about the plant or the alleged harmfulness of the plant?

B. *Investigation of the Remedial Measures*

1. Quite often the plant is simply burnt out by people but it grows again at the same place after some time. What should be the method of permanently eradicating the plant?
2. Suppose it does not cause any harm to man or his domestic animals. Should it still be removed? Why?
3. Does the plant really cause any disease to man or the domestic animals? If so, what kind of disease?
4. How to cure the disease if the plant really causes one?
5. Is any research going on anywhere in the country to curb the harmful nature of the plant (if any) to some beneficial ones?
6. Is any research going on elsewhere to eradicate the plant?
7. Suggestions for eradication of the plant.

C. Demonstration of project : (*i*) report, charts, devices and demonstration kits for exhibition, (*ii*) a small write-up for evaluation of theproject and its dissemination.

Concluding Remarks

Generation of ideas and feasibility of their implementation by a small group of school children within a limited period of time depend on several factors.

First, the problem should be of such nature that it could be pursued to a reasonable extent with modest local resources. The problem should not be too ambitious.

Secondly, while one of the purposes of the exercise is to prepare and train an alert mind in the investigator, the results of the investigation or the solution of the problems should necessarily be useful to the community.

Thirdly, a continual interchange of ideas between the members of the Implementation Cell and school children and teachers at every stage of implementation of sample projects would really pay rich dividends to all concerned with the movement. Regular contact would be facilitated through a "Science Centre" in the NCERT. The centre would offer, in addition, a scope for the curriculum developers in the Council to try-out their materials and methods for the improvement of teaching-learning of science in the schools as an entity relevant to the out-of-school activities of the children and the community at large.

The overall success of the science exhibition movement will depend much on how well it is integrated with the curricular and out-of-school activities of the children and their service to the community. □

The policy of funding science exhibitions should be appropriately designed to promote the exhibitions as a part of the above integrated approach.

Population and Resources : A Global Perspective

UTPAL MALLIK
Science Teaching Centre
School of Education
University of Maryland, USA

> *If you plan for a year, sow the seed.*
> *If you plan for a decade, plant a tree.*
> *If you plan for a century, educate the people.*
> —*Chinese Proverb*

EDUCATION is the most valid response to our heightened concern about a particular issue, and the field of population is no exception. An appropriate audience for education on population is young people, since collectively their decisions in the years to come will have much to do with shaping our future world. Their decisions in regard to schooling, career, marriage, childbearing and place of residence might be influenced by a better understanding of the causes and consequences of population growth.

With more than 4,000,000,000 passengers, it would be surprising if spaceship Earth could provide sufficient food, a comfortable cabin and a useful occupation for all of us. With another 2,000,000,000 due to come aboard in the closing years of the century, even the toughest captain would be a little anxious, particularly because certain important supplies are fast running short as the first-class passengers are extremely demanding.

But our spaceship does not have a captain. Power lies with a few scattered groups of crewmen and some better-off passengers who put their own interest first. Many of the other passengers are living in abysmal conditions. And all are reliant on the fragile biosphere for survival.

This is one of the major problems of our nice little planet. Rapid population growth, energy crisis, demanding affluence of a few, diminishing resources, pollution and social unrest, each one of these is interacting with the other leading to a future which "isn't what it used to be".

The Population Threat

Assessing the impact of population on the earth's resources is complicated analytically because population growth and rising affluence both increase pressure on the earth's resources. The effects are very similar; from 1950 up to 1973, each accounted for roughly half of the 4 per cent annual growth in the world demand for goods and services. Since then, however, global economic demand has fallen to only 3 per cent per year and the population component of the overall growth in global demand has become dominant.

United Nations projections show world population increasing from the current four billion (1976) to ten to sixteen billion before eventually leveling off. From the demographic point of view, the projections may be reasonable but when viewed against the consequent ecological stresses, technologies and social dynamics, they do not hold up. The world's major biological systems and energy resources indicate that in many places they have already reached the breaking point.

In the mid-seventies, when the world population approached four billion, the world economy saw for the first time the double-digit peace-time inflation. The four billion has also brought the highest unemployment and a marked showdown in global economic growth. However unwilling some of the affluent nations were to accept it, there were overt signs that expanding human demands were over weighting the capacity of new technology to counterbalance the inherent constraints in the natural systems and resources. The excessive demand still continues as we pace toward the five billion mark. The unmistakable signal of this demand—inflation—is on the rise throughout the world. Overall increases in demand are the direct result of the population growth. The supply increases to some extent but does not quite keep up with the demand. From 1958 to 1967, the average annual rate of inflation in the Western countries was 2.5 per cent. From 1968 to 1972, it went up to 4.8 per cent and by 1974, it was well above 10 per cent.

To sum it up all, population growth has contributed to a larger demand for resources; it is now beginning to tell on the productive capacity of local biological systems.

The world saw the first billion one thousand eight hundred and thirty years after the death of Jesus Christ. It took almost 2,000,000 years to reach the one billion mark. During each of the 15 centuries of the Christian era, the rate of population growth was 2-5 per cent. Today, in some countries, it is 3-4 per cent. The time needed to add one billion people to the world's population is alarmingly short because of the exponential nature of population growth. And if the present growth rate continues until this time next century, only one year would be needed to add one billion (Table I).

In most of the world, the population growth, however, began to subside in the seventies. In 1970, the global population growth rate was 1.9 per cent; in 1975, it was 1.6 per cent (Table II). This was mostly due to two reasons. First, in more affluent countries, there was a marked decrease in birth rates, and secondly, in poorer countries, there was a rising death rate. The excess of births over deaths, which causes population growth, fell from 69 million in 1970 to 64 million in 1975. The chief reason for this was perhaps family planning devices and growing desire to use them.

TABLE I

Years Required to Add One Billion People to the World's Population

	Year	Year Reached
First Billion	2,000,000	1830
Second Billion	100	1930
Third Billion	30	1960
Fourth Billion	15	1975
Fifth Billion	11	1986
Sixth Billion	9	1996

However, this slowing down of population growth has not been a global phenomenon. It has been concentrated in three geographic areas North America, Western Europe and East Asia.

Between 1970 and 1975, the population growth rate in North America and East Asia went down by one-third, and by one-half in Western Europe. In Western Europe, there was an unprecedented phenomenon—the population growth rate of 0.56 per cent in 1970 went down to 0.32 per cent in 1975. In North America, the annual growth rate of 0.90 per cent of 1970 became 0.60 per cent in 1975. It might appear surprising to many people that the reduction in population growth in East Asia was mainly influenced by China's more recent efforts in family planning. The East Asian growth rate of 1970 (1.85 per cent) fell substantially to 1.18 per cent in 1975. The Chinese annual birth rate of 32 per thousand (3.2 per cent) of total population went down to 19 (1.9 per cent) in 1975. Compared to this, South Asia (the Indian subcontinent) and Southeast Asia (the region from Burma to the Philippines, including Indonesia) have achieved very little. Some countries in Latin America, Africa and Middle East have reduced their birth rates appreciably but there has been a simultaneous decrease in death rates in these countries.

Western and Eastern Europes have sharply contrasting pictures. In 1970, the birth rates of East and West were quite close. In 1975, however the birth rate of Western Europe dropped below 14 (per thousand of the total population per year) and that of Eastern Europe was 18.

TABLE II

World Population Increase during 1770 to 1775

	1770	1775
World Population (billions)	3.59	3.92
Rate of Annual Increase (per cent)	1.90	1.64
Annual Increase (millions)	69	64

Fertility trends in the Americas also gave a contrasting picture. Whereas in US-Canada, the birth rate in 1975 was 15, that of Latin America was 36. In 1950, the North and South Americas had identical population size. But the present population size of North America (240 million) is much smaller than that of Latin America's 336 million. The South Americans add four times as many people to their population as do their northern neighbours.

Contrary, however, to the rest of the world, East and West Germany, Luxembourg, Austria, United Kingdom and Belgium had stable or declining populations in 1976, when the world population reached the four billion mark (Table III).

An equilibrium between births and deaths was first achieved by East Germany in 1969. It was a historic phenomenon and was repeated by West Germany in 1972. The West German birth rate of 18 in 1966 went down below 10 in 1975 and made an all-time record. Luxembourg and Austria reached the equilibrium during the 1970s. The populations of the United Kingdom and Belgium ceased to grow since 1976.

TABLE III

Countries At or Near Population Stability: 1776

Country	Birth Rate (per thousand)	Death Rate (per thousand)	Annual Rate of Population Change (per thousand)
East Germany	11.6	14.0	—2.4
West Germany	9.8	11.9	—2.1
United Kingdom	12.1	14.2	—2.1
Luxembourg	10.9	12.6	—1.7
Austria	11.6	12.6	—1.0
Belgium	12.3	12.1	+0.2

In France, Italy, Sweden, Norway, Denmark, the Netherlands and Switzerland, birth rates are dropping steadily to approach a balance with death rates. The United States has a birth rate below 15. Australia, New Zealand, the Soviet Union, Japan and Canada have birth rates between 15 and 20. In India, it is 19 (per thousand population per year). It does not require a complicated mathematics to understand what it means to India which has a population of 676.2 million and where the birth rate of 34 far exceeds the death rate of 15 (1980). Although as a harsh impact of global food scarcity, inflation, poor harvest and population pressure, the 1970s have seen rises in death rates in many developing countries including India, the annual natural increase (birth rate minus death rate) in India is 19 (per thousand people) and India would double her population in 36 years. That simply means there would be 1352.4 million people in India in the year 2016, despite the painfully high infant mortality rate of 134 (annual number of deaths to infants under one year of age per 1,000 live births).

What are the prospects for stabilizing in the very near future the world population by drastically lowering the birth rate? Due to the high proportion of young people in the US population, an average family size of 1.2 children is required to immediately stop the US population from growing. Yet, the world population is even younger. Today, more than half of the world's population is under 20 years of age. To immediately stabilize population worldwide by bringing births into balance with deaths would require an average family size of about one child per family throughout the world.

Hunger-induced rises in death rates, inflation, unemployment and a host of other population-related stresses have caused socio-political pressures throughout the globe to slow population growth. Despite their earlier views about birth control, the Chinese government has applied the demographic brakes more efficiently than many of China's neighbours in Asia. The national family planning programme in Mexico, since 1973, is likely to bring about more impressive annual economic growth than did the government's earlier pronatalist stance. The Egyptian family planning programme has reduced the crude birth rate by one point per year from 1969 to 1979. The medical community in Brazil in fact initiated the support for family planning proposing "the need to make contraception acceptable to the population as a whole as a basic instrument of social well-being".

Some governments have set specific targets for reducing their birth rates. Indonesia, for instance, hopes to reduce its population growth rate from 16 (per thousand people per year) in 1977 to 13 by 1981. Thailand proposes a 2 per cent growth rate in that country by 1981; the present Thai growth rate is 2.3 per cent or 23 per thousand. India took a birth rate target of 30 by 1983. The present birth rate in India is 34.

In February 1978, the Chinese Premier Hua Guo-feng announced that China's annual population growth rate would have to be cut to 1 per cent by 1981. At the Fifth National People's Congress, Hua said that "planned control of population growth is conducive to the planned development of the national economy and to the health of mother and child.... We must continue to give it serious attention and strive to lower the annual rate of growth of China's population to less than 1 per cent within three years. China's annual population growth is already close to 1 per cent.

The most important point to note out of all this is that population growth is not a global problem, it is essentially a local problem with global consequences. And because it is a local problem, every nation has to find its own solution so that the global consequences do not aggravate beyond control

Ecological Stresses

Directly or indirctly, survival of the human race depends on the earth's basic biological systems—fisheries, forests, grasslands and croplands With the exception of minerals and petrochemicals, these biological systems supply all the raw materials for industry as well. Except the croplands, however, the other three natural systems cannot be much improved by human management. In other words, the carrying capacity of forests, fisheries and grasslands is essentially fixed by nature. A continuously increasing demand on these natural systems, which is inevitable as the population increases, obviously outstrips the regenerative capacity of the fishery, forest or grassland.

As human numbers moved toward four billion, the demand for table fish exceeded the regenerative capacity of fisheries. Many marine biologists feel that the global catch of table-grade species may be approaching the maximum sustainable limit and it would decrease even further every day.

We have found a vast waste receptacle for oil, chemical effluents, lethal gases, radioactive wastes, junk metal, trace elements, organic-wastes, automobile exhaust products, pesticides and detergents—the sea. The marine biosphere is polluted to an unimaginable extent. Now is the time we choose whether we should preserve the oceans as food resource or use them as waste receptacle.

Deforestation undermines the fertility and stability of soils. It is a sure threat to all ecological systems. Almost everywhere throughout the surface of the globe, deforestation (for firewood and furniture, mainly) has started threatening the environment and its ability to support human life. Most of the Middle East, North Africa, a great part of Asia, Central America and some parts of South America are virtually treeless. Forests of Morocco, Tunisia and Algeria have been reduced to a tenth of their original size. The Indian subcontinent has been deforested beyond recovery and the soil's capacity to hold water has diminished causing devastating floods in the recent times. The Philippines and Thailand have the same picture. In Latin America, deforestation is proceeding at a record rate.

The grasslands are threatened almost equally by overgrazing because from biblical times until recently, the number of cattle, sheep and goats has increased apace with the human population, supplying meat, milk, leather and wool. In Western India, Pakistan, Nepal, North Africa, the Middle East and elsewhere, severe overgrazing has led to soil erosions. Croplands, which can be improved a great deal by technology, have started showing signs of stress, even in such technologically advanced countries like the USA, the USSR and Australia. The fallow land in the United States has declined by one-half during the 1970s.

The often-invisible poison of pollution is about to stiffle a great part of our human population. And pollution is a sure by-product of fast growing human population. The worldwide impact of pollution on biological systems is most evident in fisheries. Air pollution in many industrial countries has started affecting crop production.

Increase in the amount of carbon dioxide in the atmosphere, caused by burning of fossil fuels, would gradually lead to a "green-house effect". Carbon dioxide absorbs solar heat. Any rise in the carbon dioxide in the atmosphere would cause the temperature to increase.

Existing agricultural systems and settlement patterns have evolved in a particular climate. Climatic changes of any kind can disrupt those systems. An average temperature decline of one degree in the northern latitudes can reduce the growing season by two weeks. A minor reduction in temperature in the northern hemisphere could lead to southward shift of the monsoon belt in both Africa and Asia. As a result, the agricultural output would shrink with obvious consequences.

The consequences of the present pollution rate are going to be costly and destructive, ranging from the loss of cropland to severe modification of climate. Many people think that such ecological stresses are going to further intensify as our numbers and needs increase. Unfortunately, they may be right. Every year, some of the world's cropland goes out of production. The area per person shrank by 24 per cent between 1950 and 1975. During next 20 years of this century, it could fall by another 30 per cent if projected increase in population comes true. There are several reasons for the loss of cropland. The US loses 1.3 million acres of land each year to roads, airports, shopping centres, expanding suburbs and urban sprawl. Millions of acres of farmland worldwide are lost to urbanization, construction of dams, salinization, erosion and encroachment of deserts. In Egypt, 64 to 200 acres of the best cropland are being lost each year to cities, roads and factories. In Pakistan, progressive deforestation has led to severe soil erosion and the loss of cropland.

By the end of the century, twice as much land will be lost from erosion and conversion to non-farm uses as the amount expected to be brought into production. Most land to be brought under cultivation will need fertilizers, irrigation and pesticides. These modern agricultural inputs, in turn, would depend to a great extent on petroleum.

The global population grows at 2 per cent; it multiplies 7 times in a century. During 1950 to 1970, the global consumption has increased by 4 per cent. If this rate is sustained for a century, there will be a fiftyfold increase in global consumption. The earth's fragile biosphere cannot sustain that stress. And no new technology can fully compensate for that stress It has no technical solution.

None of the six countries which have achieved stability in population growth had an explicit policy of stabilizing population. But economic, social and other demographic forces converged to bring births into balance with deaths. Obviously the inherent historical and socio-economic forces in most of the less developed countries were not conducive to voluntary reduction of birth rate by their peoples. The only path to achieve a lower population growth rate is to educate the people and tomorrow's adults. Population growth not only multiplies the number of people who desire and need social essentials (aside from food and shelter) like health care, education and culture, but it also reduces the resources available to satisfy them.

A lily pond, so a French riddle goes, contains a single leaf. Each day the number of leaves doubles—two leaves the second day, four the the third, eight the fourth and so on. "If the pond is full on the thirtieth day, at what point is it half full?" Answer : "On the twenty-ninth day".

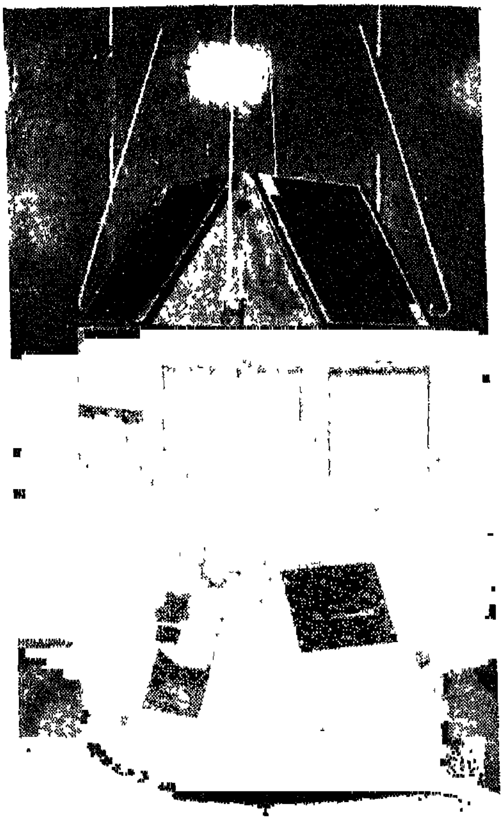
The twenty-ninth day for our world population is not far away. ☐

A Gigantic Leap in Space

MOHAMMAD KHALIL
Science Ki Duniya
Council for Scientific & Industrial
Research, Rafi Marg
New Delhi

The Indian scientists achieved another landmark by putting India among the six countries which have entered space age on their own right. India accomplished this distinction on 18th July 1980 when it successfully launched the indigeneously developed Satellite Launch Vehicle (SLV-3) to place Rohini Satellite (RS-1) in its orbit. The earlier satellites namely Aiyabhata and Bhaskara were launched from Cosmodromes outside Indian soil and the launching vehicles were also developed by other countries.

THE WHOLE nation was looking forward to this faithful hour of count down with suspense and greeted the successful launching with jubilation. The Satellite Launch Vehicle fabricated at the Vikram Sarabhai Space Centre, Trivandrum, blasted off at 8.04 A.M. from Indian Space Research Organisation (ISRO), Sriharikota Rocket Launching Range (SHAR), situated at about 100 Km north of Madras. The spectacular scene of launching of the SLV-3 was witnessed by thousands of scientists as it rose up leaving behind a cloud of smoke at its base and then disappeared leaving the trace of its path in the form of a streak of yellowish white fume in the sky.



Rohini—R.H.

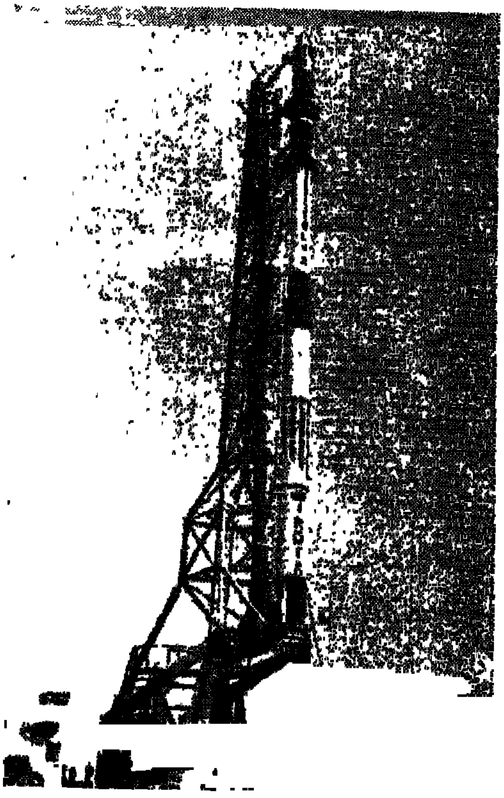
The SLV-3

The SLV-3 is a 23 metre long four stage rocket weighing about 17 tonnes. The first two stages are made of steel and all the four stages are interconnected with alluminium alloy devices. More than 46 public and private sector industries in India have contributed their mite in the development of the hardware and software for this project. The development of launch vehicle involved fabrication of many sub-systems like rocket motors for different stages and their propellants, interstages, stage separation mechanism, heat shield, control and guidance instruments and vehicle instruments. The number of such systems in SLV-3 was as large as

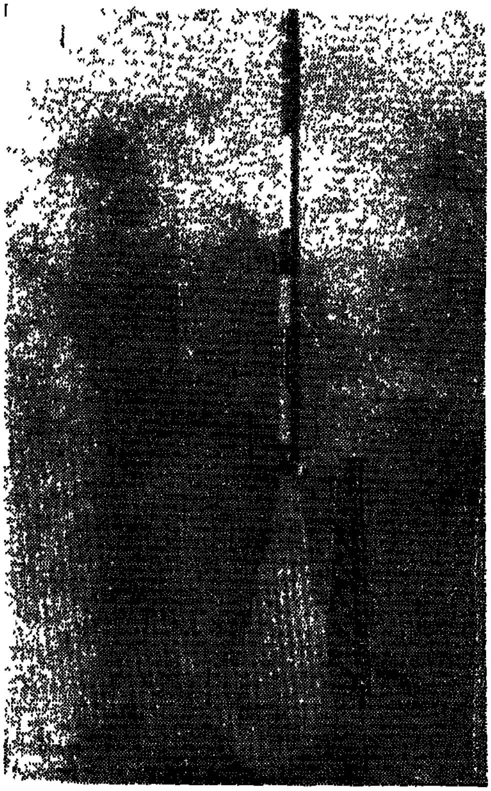
294 of which about 40 were major systems and 250 sub-systems. These systems comprised of more than 1,00,000 individual components linked together by about 40,000 fasteners. Several thousand electrical and electronic components were used in the 560 functional units of the vehicle. They included about 800 integrated circuits, 300 transistors, 450 diodes, 2000 capacitors and 3000 resistors.

A great step

The successful launching of SLV-3 has been a great step in the field of space research in India. It has helped in acquiring a very rich experience in the design, development and launching of vehicles capable of placing scientific and application satellite in near earth orbits. But this did not come in an easy way. It is a culmination of toils and failures, success and cerebration of thousands of scientists, technologists, workers and administrators as also good wishes of large number of well-meaning people. An example of successes and failures towards the final launching of Rohini Satellite is the first experimental launching of SLV-1 on 10th August 1979 which was a partial success as the rocket fell into the sea soon after it took off. This was due to the malfunctioning of the control system of the second stage of the rocket. The experience and feedback gained by the first test flight enabled the scientists to carry out minor modifications.



SLV-3



The Leap upwards

and improvements in the rocket.

On that fateful day of 18th July 1980, the payload of SLV-3 consisted of a small Rohini Satellite-1 weighing about 40 Kg. The satellite was placed on the top of the fourth stage of the rocket. The RS-1 has been designed to monitor the performance parameters of the last stage of SLV-3 which was responsible for placing the satellite into an orbit of the earth. It will also monitor the parameter of injection such as, altitude, injection angle and velocity, orbital path after injection and the house keeping data of the satellite itself while it is in the orbit.

All the four stages of SLV-3 which enabled to place the satellite in its orbit had their own fuel tanks containing solid propellants developed at Vikram Sarabhai Space Centre, Trivandrum.

Different Stages of the Rocket

The first stage of the rocket took it to an altitude of 30 Km and got detached immediately thereafter. This was followed by the tiggering off the second stage rocket which took it to a height of 72 Km within 118 seconds of its launching. The third stage of the rocket was fired after the separation of the second stage took place as expected. The burn out of the third stage rocket motor was followed by the spin-up and ignition of fourth stage which injected the satellite into an elliptic orbit with a 300 Km perigee and a 830 Km apogee. The whole operation from lift-off to its placement in the orbit was completed within eight minutes. The satellite is ever since orbiting the earth and takes 90 minutes to complete one revolution. It is expected to send back valuable data for at least three months and is being tracked by ISRO's tracking stations at Sriharikota, Car Nicobar, Ahmedabad and Thumba.

The chief men behind the success of SLV-3 are Dr. Satish Dhawan, Chairman, Space Commission and Dr. A. P. J. Adbul Kalam, Aerodynamic Engineer. Dr. Kalam has pioneered the development of rocketry in India and was the leader of the team which sent SLV-3. Dr. S. Sreenivasan an Aerodynamics Engineer was the Deputy Director of the project. He has been responsible for designing of the vehicle along with Mr. Vasant Gowarikar, Director, VSSC. Trivandrum.

Next Phase of Space

The successful launching of SLV-3 has paved the way for taking up next phase of space research programmes in India. The next stage involves development of SLV-Variants, an augmented SLV and a polar SLV. The work on these vehicles will begin within a year. These vehicles will have the capability of placing application satellites into sunsynchronous orbits. The main objective is to develop necessary technical expertise for putting up experimental communication satellite in the geostationary orbit. It is planned to place two satellites named Bhaskara-II and APPLE (Ariane Passenger Payload Experiments) in earth orbit in the next few years. Once they are launched these satellites will boost up tremendously the communication network which is so important for all-round development of the country. □

The Potential of the Biochip

J. R. BARKER
Department of Physics
University of Warwick

Semiconductor technology has brought microelectronics to the stage where the size of individual transistors on a chip approaches that of large molecules in cellular material. It is reasonable to suppose that the scale will soon be small enough for us to design circuits capable of organizing themselves into simple forms of artificial intelligence. Coupled with newly developed techniques for implanting probes in living material, they might simulate biological systems and even be capable, to some degree, of repairing them.

THE IDEA of implanting electronic systems into living tissue is not new. Cardiac devices such as the familiar pacemaker have now progressed to the stage where they embody simple microprocessors to adapt them more closely to specific characteristics of individual hearts, and several laboratories are working on microelectronic hearing devices that by pass a defective inner ear (the cochlea, See Spectrum 153) by directly exciting a smill part of the nerve bundle forming the auditory nerve. These devices use tiny electrodes, several micrometres in diameter, which are made by photolithography.

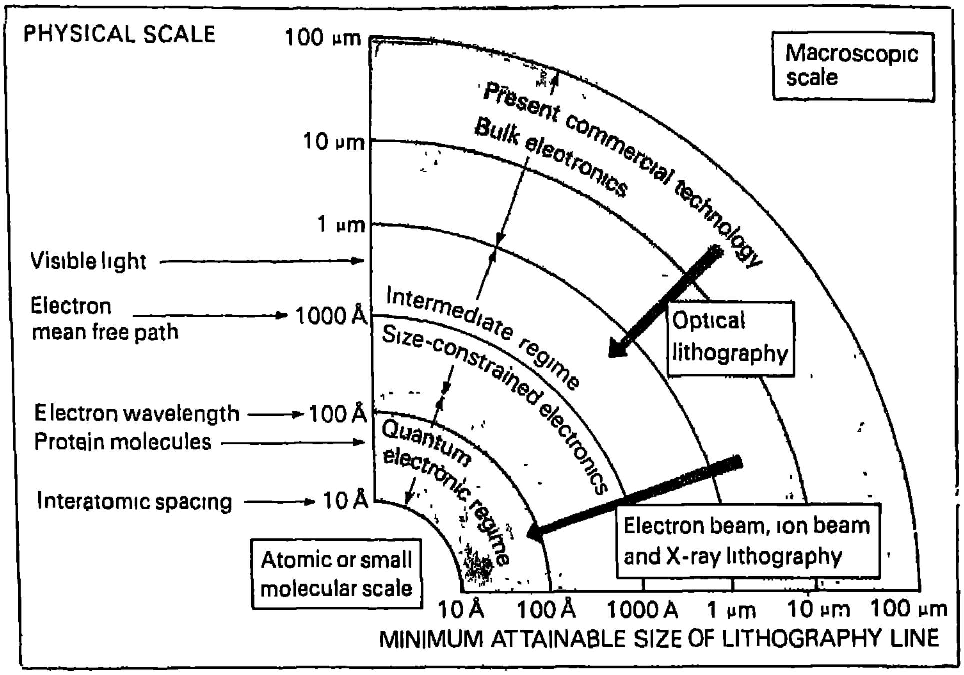
Similarly, it is possible to stimulate a precise part of the optic nerve, or visual cortex, to produce bright spots in the field of vision. By adding a micro-processor to a multi-electrode system it might be possible to pre-process and use them to build up rudimentary images of the visible world. Other work being done includes the electrical stimulation or control of defective neural units in people who are paralysed in the lower parts of their bodies or down one side. Research into the working of the nervous system, including the brain, has substantially benefited from electronic techniques for exciting and probing. But all these developments have been severely restricted by the lack of large arrays of ultra-small electrodes and miniature processing systems capable of exciting and probing in a fine mesh over a large enough portion of the neural networks, and of doing so without causing damage. So far, sensors are either too coarse or too few in number to cope with the complexity of individual cells or neural systems.

These problems could, in theory, be overcome by borrowing from the microfabrication techniques used in making silicon chips. But there still remains the problem of transmitting the information from, say, a 100000-electrode array to the experimeter. Extensive sorting and preprocessing is obviously necessary, which means incorporating a versatile, high-density microprocessor. Such as intelligent implantable sensor for monitoring and controlling might be termed a biochip.

Tissue Repair

If advanced medical instrumentation were to be developed along biochip lines it could be developed along biochip lines. It could significantly improve our knowledge of the electrical signals (and chemical ones, if chemically-sensitive ultra-small devices were used) that gover learning, memory and behaviour. From this knowledge, and by reversing the job of a sensing biochip to that of control, it would become a real, if still distant, possibility that neural tissue might be at least partly repaired.

Part of our research programme in advanced microelectronics is to study the feasibility of



Orders of size for features in silicon chip devices, showing sizes of lithography lines required

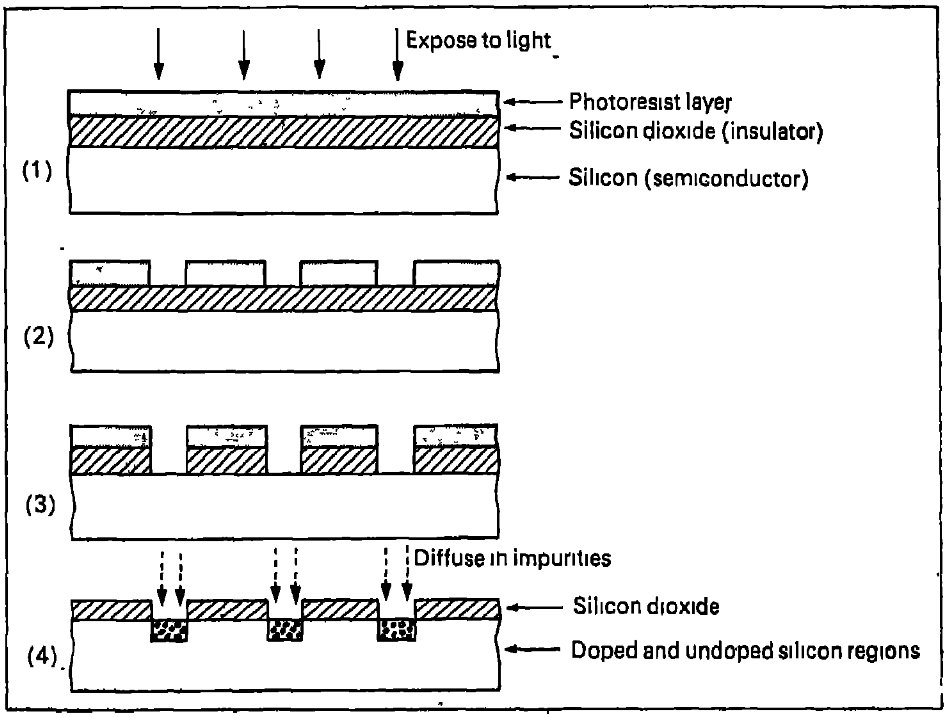
such biochip instrumentation. In collaboration with certain laboratories in the USA we are exploring problems to do with electronic processes in ultra-small devices, complex system design and bio-compatible materials important to future biochip technology. The silicon-chip revolution is now reaching a stage where further miniaturization and circuit cleverness will call for extensive changes in the way devices are made, in the design of computer architectures and even in the scientific basis for understanding and exploiting electronic processes.

Industry is now getting to the end of the era of large-scale integrated circuits (LSI), in which, typically, a micro-processor is manufactured as an array of some 64,000 transistors interconnected on a silicon-chip about four square millimetres in area and sizes of the smallest features are about two to four micrometres. Biochip developments will mean very large-scale integrated (VLSI) circuits comprising many millions of components packed on to a single chip. Individual circuit elements as small as 200 angstroms (20 nm, or 0.02 um) will be used. This is about the size of large molecules in cellular matter. Many of the ideas and techniques of bulk solid-state physics which have held for the last three decades of electronics will no longer work on this ultra-small scale.

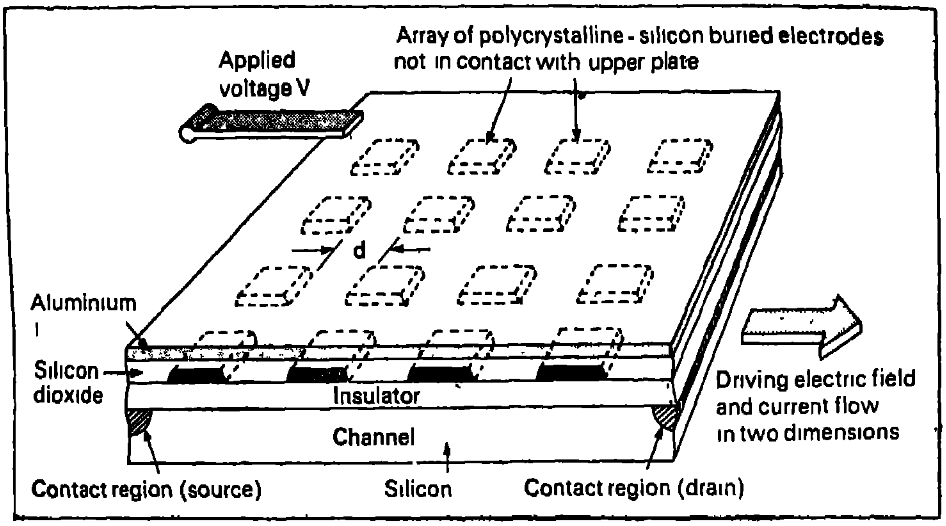
Solid-state microcircuits are built by a process which is basically photographic, known as photolithography. First, a wafer of silicon several centimetres in diameter is cut from a single crystal. Next, a thin, insulating layer of silicon dioxide is grown on its surface and coated with a photo-sensitive film, known as the photoresist. A pattern of the intended circuit is then projected onto the photoresist using a beam of ultra-violet light or in advanced lithography, some other radiation. The exposed film is then developed by dissolving away the exposed areas, leaving a pattern of open, insulator regions. These are in turn removed by etching, usually by acids, to reveal the underlying silicon surface. Very small amounts of impurity atoms may then be diffused into the open silicon regions by placing the wafer in a controlled, hot furnace containing the impurity gas. In this way, the pattern of exposed silicon is given the electrical properties that are wanted. The result is an array of planer transistors or other circuit elements. A similar procedure is used to lay down metallic electrodes and to make interconnecting pathways to link the circuits.

Photolithography is very economical because a large number of identical circuits can be made on one wafer before it is cut into separate integrated-circuit chips. By making the circuit components smaller, more components can be built into each chip, making it more versatile There are additional advantages in that smaller transistors use lower power and operate faster. Because the cost per component is related to the area it occupies on the chip, higher component density means greater economy. The number of components per chip has about doubled each year since 1960, so we might expect a million-component chip to be attained in the early 1980s.

In a move towards VLSI, recent advances in optical projection systems and the use of light in the far ultra-violet part of the spectrum show that circuit features as small as 0.5 m can be inserted into the pattern by photolithography.



Photolithographic process for making integrated circuits : (1) *An oxide layer is grown on silicon wafer, followed by a photosensitive layer*; (2) *The photo resist is exposed and the pattern etched*; (3) *The photosensitive layer is etched away*; (4) *The photoresist is etched and the impurity atoms are diffused into silicon layer. The final structure is equivalent to an array of planar transistors*


Array of polycrystalline - silicon buried electrodes not in contact with upper plate
Applied voltage V
d
Aluminium
Silicon dioxide
Insulator
Channel
Driving electric field and current flow in two dimensions
Contact region (source)
Silicon
Contact region (drain)

A two-dimentional lattice. The atomic like potential barriers and wells are electrically controllable by a voltage applied to the aluminium "get electrode"

The smallest limits are fixed in the end by diffraction effects, which can be overcome only by using shorter-wavelength radiation. Advanced lithography techniques now being developed for VLSI use soft X-rays and electron and ion beams to give a resolution of features down to the order of 100 angstroms (0.01 m). New high-precision techniques are being worked on for the etching and diffusion stages to complement the fine pattern generation and transfer; in particular, plasma etching and ion implantation are promising.

Conventional computer systems will be difficult to incorporate on VLSI chips because of the very high proportion of interconnect paths, which take up a lot of space. This 'wiring' problem is brought about because so-called sequential processing architectures are in use, in which computations are carried out as a long chain of logic operations. Parallel or concurrent architectures, in which computers can perform a large number of operations simultaneously, offer better space-filling pathways but are not as well developed. Choosing the computer architecture to use in VLSI chips will mean considerable rethinking of basic computer science; constraints imposed by the economics of design and fabrication of the equivalent electrical circuits will not be the least of the problems to be solved.

A great deal of our research effort is devoted to exploring and exploiting novel electronic processes which become available in sizes somewhere between solid-state LSI and the true atomic scale. In a conventional bulk semiconductor device, electrons or 'holes', which are vacancies in energy bands normally filled by electrons, are swept from one electrode to another through the application of a control voltage. The time this takes is called the transit time. A steady average drift velocity is reached when the rate at which the electrons gain momentum and energy from the accelerating electric field is balanced by the rate of loss of energy and momentum through collisions with impurities and vibrating atoms in the host semiconductor. Ohm's law is obeyed if the fields are weak and there are many completed collisions within the transit time. But in very small devices the accelerating electric fields can be very large because the control voltages cannot be scaled down below the thermal noise level, that is, the small voltages arising from the temperature-dependent, random motion of electrons. Non-Ohmic conduction happens easily and the very short transit times may make it impossible to achieve a steady drift velocity. This condition is called the transient regime.

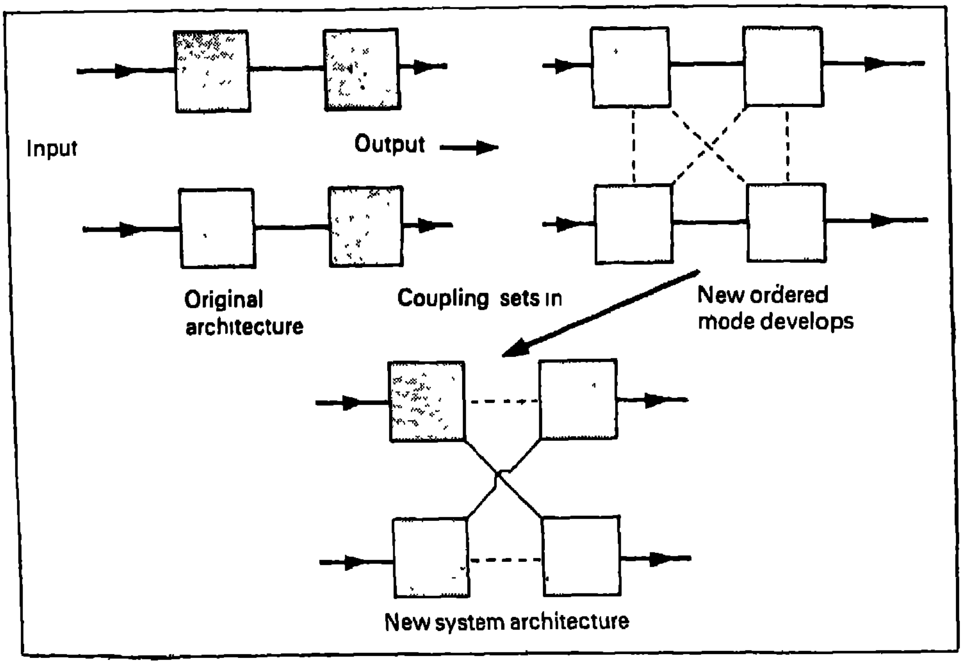
At smaller scales, the transit time—eventually becomes less than the mean free time between collisions. The conduction becomes ballistic : electrons no longer see the scattering mechanisms within the device volume, and free acceleration should take place. However, the electrons can still interact with the encroaching environment of the device, that is, with the imperfections and atomic vibrations in the contacts, interfaces and surrounding insulator regions. In this regime, conduction is constrained by size. In the extreme, when the device is small enough. Heisenberg's uncertainty relation indicates that it becomes more and more difficult to confine the electrons to the device. Quantum effects become strong, and the available energy states for the electrons become discrete rather than continuous. The wave-nature of the electron becomes a dominant factor when the size of the silicon approaches the 100-angstrom region, for the electron waves can then escape from the device and may overlap into adjacent devices; this is known as the tunnelling phenomenon. Conduction still goes on, but to understand what is happening requires the full theory of quantum mechanics.

Superlattices give us a good example of the sort of quantum effects which can be exploited in ultra-small systems. In a perfect crystal, the electronic properties of the material are foxed by a periodic array of atomic potentials, which diffract the electron waves as they propagate through the crystal lattice. An artificial one-dimensional lattice, known as a superlattice, can be superimposed on the crystal lattice by growing alternate layers of various materials on a semiconductor substrate, separated by a few hundred angstroms. By varying the composition and separation of the layers it is possible to control the electron dynamics in a direction perpendicular to the layers.

Superlattice effects have been demonstrated by a number of laboratories, particularly Dr. Ray Dingle's group at Bell Telephone Laboratories in the USA. The two-dimensional example on page 18 is of a superlattice proposed by Dr. R. T. Bate of Texas Instruments. This structure could be made by using one of the advanced lithography techniques. Applying a voltage to the upper aluminium electrode induces a periodic electrical potential at the silicon/silicondioxide interface in the vicinity of the buried periodic array of poly-crystalline-silicon electrodes. If the electrode spacing is made comparable to the average electron wavelength at the interface, these electrons will see an artificial, periodic lattice superposed on the natural, silicon lattice. By altering V and, the dynamical properties of electrons flowing between the source and drain electrodes could be drastically altered. Generalizations of this type of VLSI structure, in which various voltages are applied over different regions of the buried superlattice, are of considerable interest in our investigation of cooperative electronic phenomena to do with biochip design.

Cooperative Networks

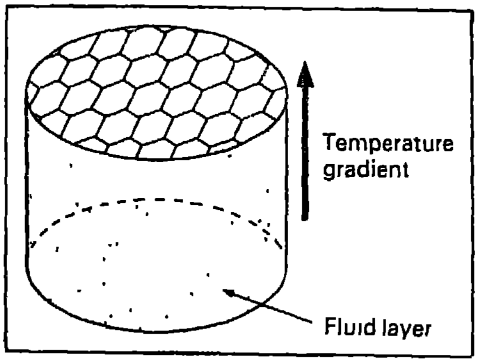
When the separation between devices approaches molecular size, it becomes more and more difficult to isolate any particular device from its neighbours. In a similar way to the superlattice example, the overall architecture of the VLSI system of devices may become more important than the host semiconductor in fixing the electrical properties of the array. Already,



A synergetic electronic network. The blocks represent groups of devices in the VLSI *array which communicate through built-in pathways and by interacting directly*

unexpected interactions have appeared between circuit elements. For example, the phenomenon of 'cross-talk' between memory cells in high-density LSI memory chips is accepted as a reliability problem. Exploiting such behaviour between devices could lead to more versatile electronic networks which would not need the high proportion of space-consuming wiring patterns that are now used in micro-processors. The behaviour of an orthodox electronic logic system is fixed once the pattern of devices and their interconnecting pathways has been established. A different behaviour might be imparted to it by rewiring, that is, re-ordering the devices, but this is normally impossible in integrated circuit systems. We are studying an alternative approach. We have built theoretical models to simulate arrays of electronic devices which are only partially isolated from each other. The arrays are intended to undergo spontaneous self-organizing, or cooperative transitions between differently-ordered electrical structures. The idea is illustrated above, where groups of devices in the VLSI array are represented as blocks which communicate through built-in pathways and by the devices directly interacting.

Information is received at the input in the form of coded electrical signals which are processed and passed to the output as additionally coded signals. At the lowest input signal strengths the array behaves according to the built-in architecture. At some higher level of input signal, cross-interactions between the devices arise through, for example, tunnelling of electrons. Competition between these new channels of communication and the original built-in coupling then gives rise to a differently ordered electrical architecture. The new architecture, and hence the new processing function, is



Example of a self-organizing system; the Benard instability

sustained as long as the input signal stays strong enough. This type of system has to have a great deal of freedom in the coupling between devices, a small number of which control the others, so many parallel paths are necessary.

Cooperative behaviour of this kind is well-known in certain physical and biological systems. Professor H. Haken, of Stuttgart, has coined the term synergetic phenomena for systems comprising many interacting sub-systems which are able to re-organize themselves and lock themselves into differently ordered structures when driven very far from their normal equilibrium. A typical synergetic effect is the Benard instability in fluid-convection: this phenomenon occurs when a fluid is heated from underneath. If the temperature difference between its upper and lower layers is small, the fluid conducts heat uniformly, but when the temperature difference exceeds a certain critical value the conduction becomes unstable and a spatially well-ordered pattern of convection sets in. At higher temperature gradients the hexagonal patterns switch to still more complex forms.

Preliminary studies are encouraging enough for us to foresee many applications for biochips embodying cooperative VLSI networks. For example, they might be used in self-healing logic arrays that would be capable of repairing a certain amount of radiation damage. They might form the basis of memory systems capable of sorting and relating data and of artificial intelligence units to assist in processes such as pattern recognition.

Implantable Electronics

Many problems, to do with the materials used, have to be solved before high-intelligence, implantable electronics systems can come about. First, the biochip must be effectively insulated against saline fluids so that it is not penetrated by unwanted dopant ions, such as sodium, which destroy semiconductor devices. The insulating layer, from a few hundred angstroms to several micrometres thick, must be chemically bonded to the chip: a conventional wrapping is incapable of preventing saline penetration to at least a few micrometres. Second, the biochip must be compatible with the host biological material, so the outer layers must be made from materials which are chemically inert, such as plastics. This poses problems to do with the interface between the outer, inert layer and the relatively active electronic layers of the chip. The layers must stick together well enough to prevent the structure unpeeling. Third, the phenomenon of electrolysis, which might cause the metal micro-electrodes to dissolve in their electrolytic surroundings when electric currents flow, poses long-term corrosion problems and may make it difficult to obviate toxic by-products. Though a number of new materials show promise, solving the problem of passivating the biochip implants will not be practicable for some time.

Bionic science is in its infancy. But in spite of design and other technological problems I believe it to be a promising area for inter-disciplinary research, with many potential benefits to medical science.

COURTESY : *Spectrum*

Voyager-I, Saturn and Space

Features that look like dark fingers of various lengths and extend across the bright "B" ring of the planet Saturn continue to puzzle US scientists getting their first close-up view of the planet through the television eyes of the spacecraft Voyager-I. "The fingers are the most baffling things we have seen so far", scientist Bradford Smith told reporters on November 6 as the "Saturn encounter" mission got underway at the Jet Propulsion Laboratory in Passadena, California.

VOYAGER-I passes closest to Saturn on November 12, but en route, the spacecraft is providing a scenic tour of the Saturnian system of 14 known moons and various rings. The dark features—several stretch the entire 25,000-kilometer-width across the "B" ring—baffle scientists for several reasons. "We don't know what they are, to begin with", Smith said. "Are they dark because we are seeing through the ring particles into black space? Or are we looking at dark particles in the rings?" Smith asked.

But the more curious aspect of the features is that they maintain their structure day after day. The "base" of the fingers are closer to Saturn while the finger tips are farther away and are revolving around Saturn at slower speeds. Thus the base of the "fingers" should have been sheared off. "Yet there the particles are—stretching for thousands of kilometers—all lined up dark", Smith said.

As the Voyager-I spacecraft closed in on Saturn at a rate of 15.4 kilometers per second, got closer and closer to the rings, more and more "structure"—divisions and features—become apparent.

"There was an enormous amount of structure there—hundreds of ringlets within the larger rings", Smith said. Previously, scientists thought that moons orbiting in the ring area would cause divisions in the rings. But there are not enough satellites to account for all of the divisions. "We are having serious problems with our theories that account for the ring structure—how it is maintained", Smith said.

The rings of Saturn—debris, such as ice and dust—are a prime target for Voyager's two television cameras. They photographed the rings from various positions, from both above and below the ring plane, and from the sun-side as well as the far side of the planet. Saturn is twice the distance from the sun as Jupiter, which the Voyager-I spacecraft passed in 1979. At such distances, Saturn receives only one-fourth as much sunlight as does Jupiter, and one-hundredth the amount that strikes earth.

Scientists expected, therefore, that the close-up views of Saturn's satellites would show evidence of their icy surfaces, although some of the moons might well have a rocky interior. Saturn, for example, is largely gas—hydrogen, helium and ammonia—but it may have a rocky core 15 to 20 times the mass of earth but about the same size as earth. The banded atmosphere of Saturn, like that of Jupiter, probably represents jet streams of ammonia and other compounds spinning around the planet at different altitudes and speeds. Because of the colder temperatures at Saturn, the clouds probably form deeper in the atmosphere overlain by a layer of haze, and therefore not as bright as the clouds of Jupiter.

Early November 6, the Voyager returned pictures of the largest moon in the solar system—Titan. Titan appears covered by an orange haze—a photo-chemical shroud of hydrocarbons similar to the smog that hangs over some cities during hot summer days. Yet, even

New features in the rings of Saturn that have never been seen before appear in these four photos taken by NASA's Voyager 1 on Oct. 4 and 5, from a distance of 51 million kilometers (32 million miles). The photos have been computer-enhanced to bring out faint details in Saturn's rings. These are the first photos to show irregular patterns in the rings. Visible in these photos of the rings are patterns of dark, fingerlike areas that rotate around the planet like spokes in a wheel. Studies of the photos reveal that some retain their identities for several hours, despite the fact that at the inner edge of the new features, ring objects orbit Saturn once in 7½ hours, while particles at the outer edge take more than an hour longer. Therefore, spokelike features like these should be erased as the inner objects race ahead of the outer ones. But some have been observed that last three or more hours. It is unlikely, according to the scientists, that the new features are composed of dark objects. Rather, they are more likely to be regions where there are fewer objects, reflecting less light than other parts of the rings. (Small, square smudged areas are reseau marks engraved on the camera, and not features of Saturn or its rings.)

at a distance, scientists were beginning to see "features"—slight differences in shading and colours—on Titan's disk. As the spacecraft gets nearer and nearer to Titan—within 7,000 kilometers, November 11—scentists should be able to determine whether or not Titan's surface is completely shrouded by clouds of methane and other gases. "We are on our way for an interesting ride through the Saturnian system", scientist Edward Stone said on November 6.

Following are highlights of the "mission events" :

(*i*) November 6. Voyager photographed Saturn and its rings, and the moons—Titan, Rhea, Dione, Mimas and Iapetus.

(*ii*) November 7. Voyager's pictures of Saturn were used to search for new moons of the planet. Fourteen moons have been identified so far. Two of them were discovered on Voyager pictures. The moon Iapetus will be photographed to determine why one side of its disk is bright and the other side dark.

(*iii*) November 8. Photographs of the moons—Tethys, Enceladus, Rhea and Dione were taken as well as pictures of Saturn.

(*iv*) November 9. The infrared instrument will scan Saturn taking measurements of the "heat" across the disk. Saturn emits more heat from its interior than it receives from the sun.

(*v*) November 10. Studies were made of Titan's atmosphere and of any visible surface. A total of 427 photographs will be sent to earth on this day.

(*vi*) November 11. Closest approach to Titan. Instruments will measure Saturn's magnetic field and record any high energy particles in the vicinity of Saturn.

(*vii*) November 12. Voyager-I flew within 125,000 kilometers of Saturn's cloud tops, past the planet's South Pole, and then behind the planet and up through the ring plane. Voyager travelled at about 31 kilometers per second. At this speed, it took the spacecraft barely a minute to travel the distance from New York to Texas.

On the same day as its closest approach to Saturn, the spacecraft made its closest approach to the moons Tethys (within 415,320 kilometers), Mimas (108, 400kilometers), Enceladus (202,521 kilometers), Dione (162,000 kilometers) and Rhea (72,100 kilometers).

(*viii*) November 13. The cameras photographed the rings of Saturn from over the North Pole. Other instruments searched for lightening and auroras in Saturn's atmosphere on the darkened far side.

(*ix*) November 14. Closest approach to Iapetus occurred at a distance of two million kilometers.

(*x*) November 15—November 18. Cameras searched for more moons and took additional photographs of Saturn.

Hundreds of Rings

Photographs from the American Voyager-I space probe of Saturn and its rings are casting doubt on numerous traditional theories about the planet although the spacecraft is still eight million kilometers from the planet, a senior project official said. The photographs also cast doubts on other traditional theories about the composition of the planet and its rings previously considered to be made of dust and ice.

"Black fingers" found on the interior of Saturn's rings recently is only the beginning of a series of surprise, Professor Smith said.

Voyager in Saturn's Territory

Voyager-I, extending man's eyes over nearly two billion kilometres of space, entered the exotic realm of Saturn as it pierced the boundary of the giant golden planet's magnetic field. The ship, already delighting scientists with new mysteries about the planet, its rings and 15 known moons, entered Saturn's protective mag-

netic sheath. Called the Bowshock, the boundary marks the 1.4 million km from Saturn where the planet's magnetic field is strong enough to deflect solar wind, a stream of particles from the sun.

The ship, battered but healthy after a voyage of 38 months and two billion km, showed earthbound scientists the first of seven new worlds as its route skimmed just 4,000 km from mighty Titan, a red-orange giant that is the biggest moon in the solar system.

Saturn's rings, a vast sheet of snow ball-like debris, already have been revealed by Voyager as a complex system, with dozens of small ringlets forming perfect circles within circles. Mr. Bradford Smith, leader of the camera team had said that even the series of concentric ringlets could not be explained by the traditional theories of ring structure. For the newly found, uncircular ringlets, he said that "we really don't have an explanation. It was certainly most unexpected".

Braids Inside Rings

Pictures from the spaceship received at a tracking station in Canberra and relayed to the USA were described by scientists as magnificent. Received in Canberra at the speed of light and clearly visible on large screens, they showed mysterious twisted rings. The pictures and data showed natural processes vastly more complex and intriguing than had been imagined. The seemingly simple ring system turned out to be hundreds of rings and ringlets, some jagged, others sharp, spoked, smooth, straight or braided.

The spacecraft entered a potentially dangerous period had to glide above the plane of the rings, through an area believed to be free of the debris and ice that form the rings. But there was the possibility that it might hit something.

The spaceship found two narrow bright ringlets that appear to be twisting about each other like crud braids within Saturn's thin outer F-ring It boggles the mind that it even exists.

Voyager had earlier mystified scientists with discoveries of dark spokes reaching across the brightest part of the ring and hundreds of tiny, thin ringlets making up the ring structure. The craft also found at least two non-conforming rings which are mysteriously misshapen.

"When we looked at the F-ring....we saw two bright components and they appear to be braided. The strange picture showed a slightly dimmer ring that seems to loop in and out of a larger brighter ring.

Mr. Smith said he could offer no explanation for the braided rings. After covering 2 billion km in a circuitous route to Saturn, Voyager came within about 19 km of the predetermined bull's eye near Titan, a thick, smoggy haze denied scientists a look at the never-seen surface of Titan But, nonetheless, they reported hints of streaks and other vague details on the orangish clouds surrounding the moon.

During the Titan encounter, Voyager's radio signals were received at a tracking station at Madrid, Spain where five hours of data was lost because of foul weather.

Voyager dashes Hopes of Life Process on Titan

Saturn's giant moon Titan appears to be an ocean of liquid nitrogen with ammonia and methane icebergs too cold to support any kind of organic life, according to scientists examining data from Voyager-I.

The scientists, who had hoped the spacecraft's pass near Titan would provide clues to the origin of life on earth, said that all previous conceptions of what the moon might be like, appeared to be wrong.

Astronomers had previously expected Titan's atmosphere to be made up of clouds of hydrocarbons, the basic chemical building-blocks of organic life, rained onto a surface of frozen water. Scientists at the Jet Propulsion Laboratory said data from Voyager show there are fewer hydrocarbons in Titan's atmosphere than had been thought and that the extremely low temperatures precluded any chemical reactions that could have led to earth-like life.

"When you look at Titan....in the picture, you get the mental picture of a murky swamp", said Dr. Von Eshelman of Stanford University, head of the radio science experiment in the project. He said there appeared to be some hydrogen cyanide one of the chemical predecessors of organic life in Titan's atmosphere and it was possible that pre-biological reactions occurred on the tops of Titan's clouds. But the products of any such reactions would have fallen to the surface to be frozen solid by the liquid nitrogen.

Dr. Eshelman said that preliminary data caused scientists to believe atmospheric temperatures on Titan might be minus 98 degrees Centigrade at the cloud tops to minus 206 degrees near the bottom. He said the best guess of the temperature at the surface, which was not measured, was minus 183 degrees Centigrade.

Dr. Rudolf Hanel of the National Aeronautics and Space Administration (NASA) said Voyager's instruments had not produced any data about the surface but it may have an atmospheric pressure near that of earth or slightly more.

The photographs sent one and a half billion kilometres through space, indicated intense meteoric activity around Saturn through its many pock-marked moons one of which, Mimas, bore a crater described as a kind of

"Cosmic breast" by scientists at Voyager's jet propulsion laboratory at Passadena in California.

Organic link

But it was the US space probe's passage near the planet's largest moon, Titan, that most excited scientific imagination throughout the world with the discovery of molecules believed to be early links in the organic chain of life, These discoveries are particularly interesting because the evolution of Titan provides a time machine to look back into the possible evolution of life on earth.

As a French astronomer, Mr. Audouin Dollfus, explained : "Saturn is a fossil of the past. A snapshot of the evolution of the solar system at a given moment". On Titan, the intense cold is believed to have stopped the evolution. He explained . "On earth, water was able to take the liquid state necessary for the development of life. And so far nothing has confirmed that liquids other than water can substitute for it in this life-creating process.

"Still, the absence of life and rapid chemical evolution in the saturnian system does not indicate that nothing much is happening. On the contrary, the planet with its rings and moons is a veritable brain-teaser for experts in cosmic mechanics".

Meanwhile, the discovery of more than one moon in the same orbit and of moons travelling at different speeds according to their distance from Saturn's centre mean that if the laws of universal gravitation remain correct unknown phenomena are intervening "to modify the saturnian system", Mr. Dollfus said.

The Journey after Saturn

Voyager, with a one-tonne laboratory mounted on a shiny-dish-shaped entenna, left Cape Canaveral. Florida, on 5 September 1977. After its close encounter with Saturn, ths hip will leave the solar system and begin an endless voyage among the stars. A sister ship, Voyage 2, is to reach Saturn next August and may continue still deeper into the solar system to give man his first look at Uranus in 1986 and Neptune. When Voyager-1 leaves the planetary system, will head out of the solar system to begin an endless journey among the stars.

In case any extraterrestial beings come across the wandering spacecraft, there's a gold-plated record with greetings from earth mounted on Voyager-1. The record, called "sounds of earth", includes animal noises, rock and folk music 115 protographs and diagrams and a message from President Carter that bears "greetings from....a small, distant planet".

The record a 12-inch copper plaque with earthly greetings in 60 languages also has messages from world leaders the earth's location, and scientific theory.

"Because space is very empty, there is essentially no chance that Voyager will enter the planetary system of another star", said astronomer Carl Sagan, who along with a team of experts in numerous fields put together the written and aural human record.

"The spacecraft will be encountered and the record played only if there are advanced space faring civilizations in intersteller space", Mr. Sagan said.

Mr. Sagan was responsible for plaques with similar messages that were sent into interstellar space on Voyager predecessors Pioneer-10 and 11 which both passed by Jupiter, Pioneer-12 saild past Saturn and on into deep space in September 1979.

Voyager's phonograph record is contained inside an aluminium protective jacket that should give it a one-billion-year life. Instructions in detail how to play the record with the cartridge and needle provided.

Courtesy : *American centre*

Dangerous Dust

W. A. Bloor
Industrial Hygiene Department
British Ceramic Research Association
Stoke-on-Trent

In the field of industrial health, the most important and difficult problem to be tackled by those who manage factories is dust. Various sources of dust have to be recognized, and certain basic principles applied to suppress it or, if that is impossible, at least to control it.

Dust is invariably a nuisance. It may damage equipment and harm processes, and, more importantly, it is often a danger to health. Some dust damage the lungs directly, others may damage the body in other ways.

The danger to health and the way that dust particles behave in the air depend a great deal on how big they are. In measuring the sizes of dust particles, the unit commonly used is the micron (m) which is a thousandth of a millimetre. The thickness of a human hair is around 70 m. The smallest particle visible to the unaided eye has been variously put at anything from 10 to 50 m but a lot depends on the type of lighting under which it is viewed.

The physical properties of small particles have been studied for many years but applying some of the knowledge so gained to dust problems is comparatively recent. One of the most important characteristics of small particles is their so-called 'terminal velocity'. When a solid object falls in air it does not accelerate indefinitely: eventually it reaches a speed at which the resistance offered by the air equals its weight, and thereafter it falls at a constant speed, that is, its terminal velocity.

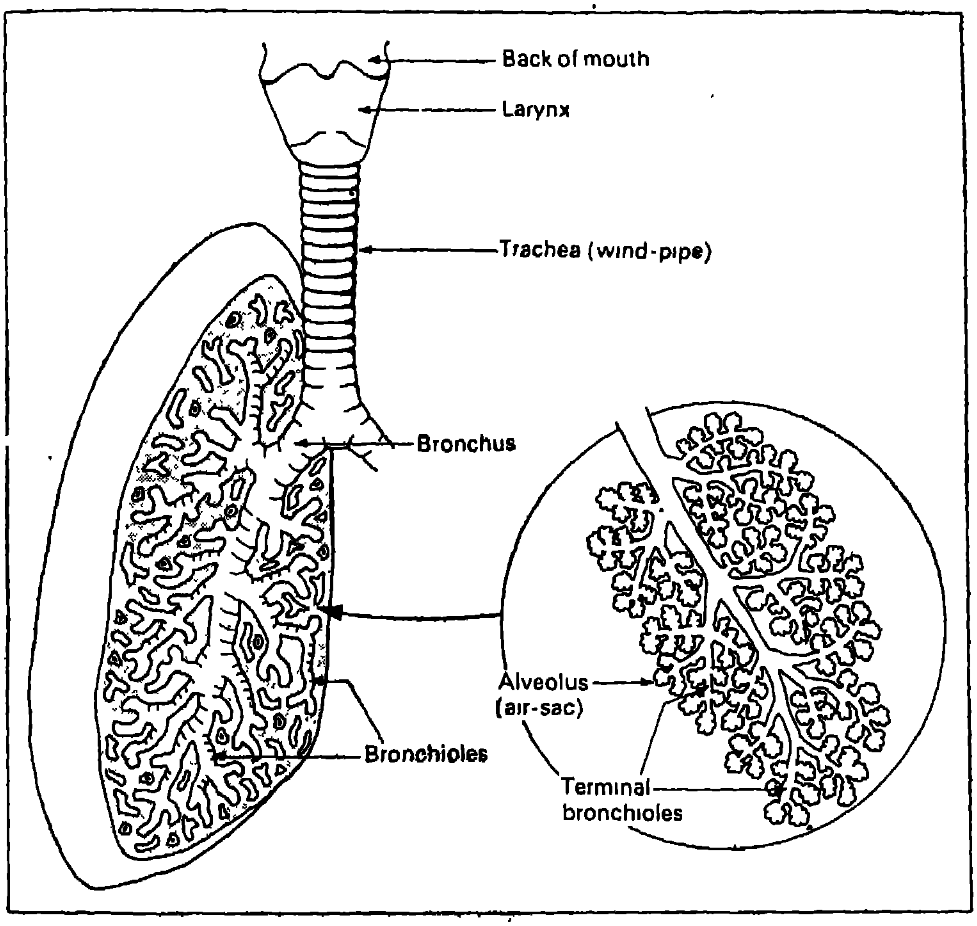
The terminal velocity of a 100 m particle of silica, for example, is about 0.3 m/s, but it takes a 1 m particle 10,000 times longer, or about 2½ hours. to fall 0.3 m even in still air. So, suspensions of fine dust in the air have great stability and in a sense the fine particles become part of the air itself; they have no appreciable motion of their own relative to the air in which they are suspended.

Biological Effects

A shaft of sunlight across a darkened room clearly reveals that the air we breathe contains vast numbers of particles, both naturally occurring and man-made. We survive in such conditions through the ingenious and remarkably efficient air-conditioning and particle removal equipment in our respiratory system. These particle removal devices are good enough to cope with almost all natural and domestic dusts, and to deal with small quantities of some other dusts which, in higher concentrations, would be dangerous to health.

Dusty air entering the nostrils has to pass through a number of hairs which, with the change of direction that occurs at the top of the nose, serves to trap many of the larger particles and some of the smaller ones. At the same time the air stream is warmed and humidified to make it more acceptable to the deeper and more delicate parts of the lungs.

The air enters the lungs via the windpipe. This path soon divides into bronchi, which in turn divide and sub-divide, each successive branch being of a progressively smaller diameter. The very smallest branches end in the final air-spaces of the lung, called alveoli or air-sacs, where the gas exchange takes place between the blood and the inhaled air. Oxygen is taken up by the red blood cells and carbon dio-



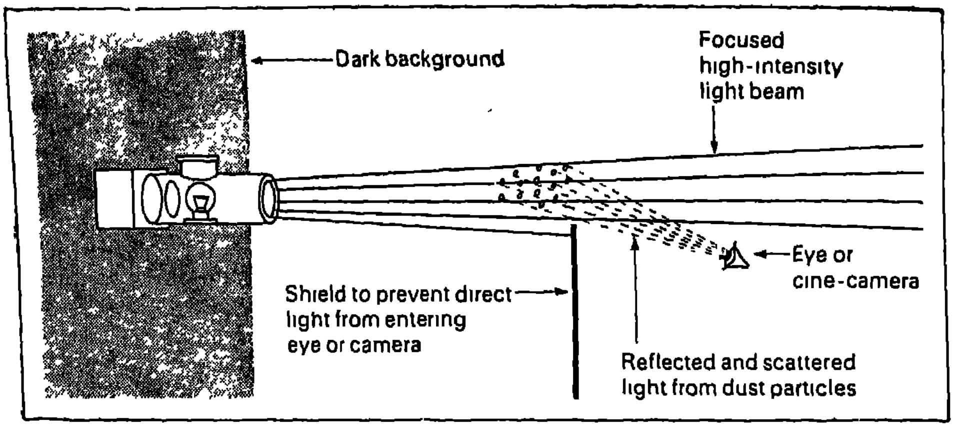
Digrammatic section of right lung. The enlargement shows the areas where the red blood cell taken up oxygen and give off carbon dioxide

xide is given off. The estimated total surface area of the air-sacs is about 80 m^2.

Mucus

All but the smallest of the airways of the lungs are lined with a layer of sticky mucus which moves continuously upwards towards the throat. Large particles are unable to negotiate the many bends and corners in the airways and they collide with this sticky lining. This upward-moving mucus escalator serves both to trap and remove these larger particles from the lungs. In people who breathe through their mouths, most of the particles which would otherwise be filtered out in the nasal passages are trapped and removed in this way.

Many of the smaller particles, however, particularly those below 5 m diameter, are able to negotiate the maze of branching tubes without touching the sticky sides and they find their way into the air-sacs. Obviously, the walls of these air-sacs must be kept clean so that gas exchange can take place unhindered This is


Dark background
Focused high-intensity light beam
Eye or cine-camera
Shield to prevent direct light from entering eye or camera
Reflected and scattered light from dust particles

Arrangement of lighting to reveal fine dust-particles. An intense, focused beam of light is set up against a dark back-ground and the observer looks towards the source at an angle of between 5 and 15 degrees. In this way it is possible to see smaller particles than are normally visible. By moving the beam from place to place it is possible to find out how, when and where dust is produced

where the lungs' second line of defence comes into operation. Within the alveoli there are mobile scavenging cells whose job it is to engulf any foreign particles. They move out of the air-sacs with their load of dust and eventually deposit a great deal of it in the lymph glands at the roots of the lungs.

Once this inhaled dust has been deposited in the respiratory system, one or more of a number of things may happen to it. Soluble particles pass into solution in the lung fluids and become distributed throughout the body. This happens to many non-toxic substances and many poisons, too, such as lead.

Particles that are insoluble remain more or less permanently in the lungs or the lymph channels or glands; they may or may not be harmful. Certain insoluble metals and their compounds appear to be quite inert when deposited in this way, but some other metallic dusts and their compounds produce acute inflmmation of the lungs. Some organic dusts are extremely irritant and induce a sensitivity which produces severe reactions whenever the victim is again exposed to the dust. Some dusts are associated with cancer of the lungs: the one best known is asbestos.

Pneumoconiosis

The dusts of most interest to industry are the ones that give rise to pneumoconiosis, the lung disease. Nowadays, the terms pneumoconiosis is used in a general sense to describe the group of lung diseases characterized by fibrous tissue of the lungs. Best known and most important of the pneumoconioses are silicosis and asbestosis. Asbestosis is relatively new, for it did not become clearly established as a separate disease until about 1930. It is a fibrosis of the lung differing in character and distribution from that produced by silica. The word silicosis is now generally reserved for disease caused by exposure to dusts consisting of almost pure silica. Many of the dangers in industry come from dusts made up of several different minerals, free silica included. Any disease produced from such mixtures is usually referred to as a mixed-dust pneumoconiosis.

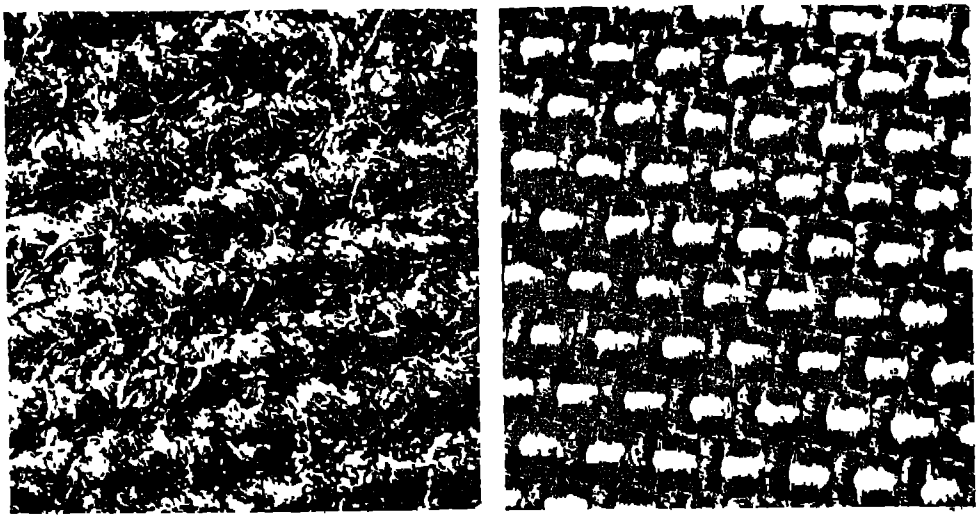
Fine particles of free, crystalline silica reaching the air-sacs are, in common with other fine particles, quickly removed by the mobile scavenging cells and deposited in the lymphatic system. Unfortunately, these particles of crystalline silica are able to kill the scavenging cells. The dead cells then induce adjacent healthy cells to produce fibres to enclose and isolate the dead ones. Because this fibrous tissue is not as elastic as normal lung tissue, the working of the lungs is impaired, giving rise to breathlessness and a strain on the heart. It is often supposed that such breathlessness is due to physical blocking of airways by large amounts of dust. That never happens. The lungs of people with quite severe dust disease may contain only a few grammes of dust.

Obviously, in dust control and dust suppression work the main task is to tackle those particles that are able to find their way into the air-sacs, that is, the so-called respirable-size particles. A committee of the U.K. Medical Research Council has defined respirable-size dust as being those particles that have a settling or terminal velocity in air less than that of a 7-um sphere of unit density. This is roughly true for a quartz particle of about 5-um diameter.

Dust Sources

Dust arises in factories in many different ways. The raw material may be dusty, dust may be produced during its processing or the end-product itself may be a dusty material. In some industries the dust is a by-product of processing operations (for example, in cleaning metal castings) or there may be a stage in production where the partially finished product is friable and dusty (as in the pottery industry).

The terms 'process dust' and 'general-atmosphere dust' are often used in discussing problems. The former refers to dust directly created by a specific operation, and the latter to dust that gets into the air of a workroom from many minor sources such as floors and benches. A less obvious source of dust, but nevertheless an important one is the worker's



Left : Magnified view of a cotton drill fabric showing dust collected. Right : The relatively smooth surface of a fabric made entirely from Terylene clothing. Contact with dusty materials, or with wet materials that subsequently dry out, can make clothing a servious secondary source of dust. I will come to this later.

Assessing Dust

The degree of dust control needed in an industry must obviously be related to the risk, which in turn depends on the composition of the dust particles, their size and their concentration. Although substantial quantities of any dust are offensive and must be controlled, even minute amounts of some dusts can be very harmful. So it is essential to collect and evaluate suitable samples of the airborne dust, and then find out how it is being produced.

When estimating the risk to health, it is essential that the samples taken in the worker's breathing-zone by using a personal, self-contained sample. If necessary, it can be worked for several working days to give a better assessment of personal exposure than was possible just a few years ago.

Although discovering dust concentrations and composition is important, it may give little or no indication of where fine dust comes from. Dust capable of causing disease is not normally visible in ordinary lighting, but it has to be controlled to make working conditions safe. One invaluable tool for investigating dust problems is based on what has become, known as Tyndall-beam lighting. This is,in effect, a portable sunbeam with an intense focussed beam of light and a dark background. By looking up the beam towards the source of light at an angle of 5 to 15°, it is possible to see particles smaller than the smallest size normally visible. They are clearly revealed against the dark background. The beam can be moved about to various positions so that the whole of a dusty process can be examined to find out just how, when, and where the dust is produced and the way the dust is spread from its source.

Dust Control

Obviously, where there is a dust hazard there is a need to eliminate or control the dust. The best possible way of eliminating it is to stop making it but if this cannot be done it is always worthwhile getting rid of some of it, because it leaves less to be controlled. The hazard can sometimes be dealt with by substituting a safe material for a dangerous one, or by changing the process in some way such as using wet-process techniques instead of dry ones.

When the dust cannot be eliminated or suppressed at source it is necessary to control it in some other way. Discrete sources of dust can usually be controlled well enough by enclosing them and using exhaust ventilation. There are three essential parts to an exhaust ventilating system; the enclosure, or hood, the dusting and the dust collector. In other words it is necessary to capture the dust, to carry it away, and to dispose of it safely. Capturing the dust is by far the most important and often the most difficult part, but unless it is done effectively the rest of the system is largely a waste of money.

Capture

The principles involved in designing duct work and in the design and selection of dust collectors were developed long ago. They are well established and generally well understood by ventilation engineers. But many installations fall down badly on what is the most important job—capturing the dust in the first place. I have already pointed out that suspensions of fine dust in air are highly stable and that, in a sense, the particles become part of the air itself. Controlling fine dust, therefore, means controlling the air movements to do with a dusty process. In some instances they cannot be halted without stopping the process. In such cases the exhaust system must be designed to control the moving air. In other cases the movements should be stopped, controlled or diverted before exhaust ventilation is applied. If they are not, the ventilation system will have to cope with them and it will have to be much larger and more expensive than it really need be.

In the mechanical handling of materials, enclosing the sources of dust and using exhaust ventilation usually solves the problem. The design of the enclosures must take into account many factors to do with the types of mechanical handling machinery. The simplest cases are those where it is possible to enclose particular items of equipment completely, except for small openings to allow the material to enter and leave the enclosure.

For dusty processes where workers use hand-held tools, things are not simple because only partial enclosure of the dust source is possible. Designing exhaust hoods and booths for hand operations involves aerodynamics, ergonomics, design skill and not a little ingenuity. The use of the hood or booth might also mean a change in the way of working, so some applied psychology is often called for, too.

Although exhaust hoods for dusty processes should reduce workers' exposure to a low level, investigations in the pottery industry showed that protective clothing was itself an important source of secondary dust. The fabric most commonly used for it was a cotton drill, and cotton has a high capacity for collected dust. When dust has been picked up it is released again merely by touching the surface or even by slight agitation of the fabric when the worker moves. Dust released in this way at the front of the overall is carried up to the face through the air convection currents that the warmth of the body produces.

Surface Area

The effective surface area of a typical cotton drill fabric, that is, the entire surface area of the individual fibres to which fine dust particles can adhere, is some 50 times the normally-measured area. This means that the one square metre or so of overall covering the chest has an effective area of about 50 square metres.

Laboratory tests of numerous alternatives to cotton showed that fabrics made entirely from Terylene filament picked up little dust because of the absence of hairs on their surfaces. Over 70 different Terylene filament fibres were tested, and although all of them had a low dust 'pick-up' they differed in their resistance to dust penetration and in their resistance to the passage of air. The ideal fabric would have a high resistance to the passage of dust so as to avoid contamination of underclothing, and a low resistance to the passage of air so as to make it easy to ventilate the body. In a non-hairy fabric, such as filament Terylene, these two properties are incompatible. It was therefore necessary to accept fabrics that represented a compromise between the two requirements.

Having defined the quality of the fabric to be used, it was necessary also to consider the question of design. In conventional designs of overalls there are some highly undesirable features. At the front of the garment we often found pockets and pleats which held dust, and openings and buttonholes which let dust through. It was necessary to eliminate all such drawbacks; an essential feature in the design was a completely plain front with back fastening. The new designs were officially recommended to industry.

In a random sample of 43 workers making earthenware from a plastic clay body, the change from cotton to Teryelene overalls showed reductions of up to 65 per cent in the dust concentrations in their breathing zones; the mean reduction (34 per cent) were achieved for some sanitaryware casters whose working procedures grossly contaminated their cotton overalls. Indeed, the dust from their cotton overalls was found to be the most important single source of the dust to which they were exposed.

To identify progress in the field of industrial health is often difficult, but it now appears that the worst of the pneumoconiosis hazards have been eliminated from the pottery industry in the UK. Dust exposures in the industry are still being monitored and measurements show that the processes which in the past have been big hazards have been effectively brought under control.

COURTSY : *Spectrdm*

Let's Build Papier-mache Models

SHAKUNTALA BHATTACHARYA
DESM, NCERT
New Delhi

No doubt you have often faced the problem of building models, clay and plaster of Paris are the two things that commonly come to mind. However, clay (such as that used by potters) and plaster of Paris may not be easily available. Besides, such models are very heavy and fragile. There is however a very siuitable material for such applications and that is papier-mache which is light, fairly durable and easy to make from locally available resources, newspapers and paste Models made of papiermache are of two types : those using strips of paper and those using papiermache dough.

I. What will we need to start on this project :

Paper—Newspapers are of course the most readily available material. You can also use paper towels, lining paper, crepe paper, and paper tissues. Magazines, especially the glossy kind, are not suitable.

Paste—Cellulose paste, starch, cold water paste supplied in powder form and flour paste may be used. If you cannot lay your hand on any of these, then glue will suffice.

To make *flour paste* mix a tablespoon of flour (*maida*) with cold water to make a smooth cream. Pour on boiling water, stirring as you do so. The mixture will change its texture and appear transparent. Allow it to cool. A few drops of oil of clove (You can get it from a druggist as it is commonly prescribed for toothaches).

For *Starch paste* make a starch as for laundry but of a very thick consistency. The paste must be stored in a wide mouth container so that paper can easily be dipped into it.

You will of course need a number of other things depending on what method you are using and what you are making.

II. Using paper strips

Tear the newspapers into long 1-1½" wide strips. Do not cut the strips with scissors as this gives a hard edge which is not suitable. Make enough paste for the project. You will also need a vessel of the shape that you are intending to model and slightly smaller than it. For a start let us use a stainless steel shallow bowl. Coat the outside of the bowl with a layer of grease/oil so that the paper strips do not stick to it. Now dip suitable lengths of the newspaper strips in paste and lay them side by side on the bowl, in the same direction, taking care not to overlap the edges, but at the same time there should not be gaps between the strips. The strips should be long enough, so that at least an inch should protrude out at each end over the edge of the bowl. On no account should these strips be folded over the edge of the bowl, or else it will be very difficult to remove when dry. Now put a second layer of strips crosswise on the first layer again taking the same precautions. Repeat the layers alternately in each direction. You will need about 8-9 layers of strips to get enough thickness. Keep track of the number of layers by using some sort of an indicator. Be sure that each layer is smooth, wrinkle free, and covers the whole surface. Allow the cast to dry for a few days then gently pry it loose it from the stainless steel vessel. The mould should come away easily when the papiermache is dry. You should now have a papiermache bowl slightly larger than your dummy. Cut the edges smoothly with sharp scissors. The rim should now be neatened and strengthened. This is done by pasting small strips of paper over the complete edge.

Normally the dummy used for making models with paper strips have a wider top than base to ensure removal of the vessel. However to produce shapes with narrow mouths or uneven shapes two procedures may be used. An air-filled toy balloon may be used as the support base, in which case it may be deflated and taken out. The grossly uneven structures like animal-forms, a wire inner structure may be made, filled with crumpled newspaper and then the strips may be applied in the usual way. Rolls of newspaper may also be used as support base especially for animal figures.

III Making and using papiermache dough

Shred the newspapers into small pieces. Do not use scissors to cut them as the hard edges thus produced hinders pulping. Soak the shreds overnight in a bucket of water, drain off the surplus water. Beat the pulp obtained on the floor with a stick, rolling pin mallet, pestle or similar object. Alternatively you can squeege and rub the mixture with your hand. For quick pulp making you may boil the mixture for sometime instead of soaking. Boil the mixture slowly, stirring occasionally. See that there is enough water in the pan always. Do not allow the pan containing pulp to burn dry. Pulp obtained in this way may be beaten in the same way as pulp obtained by soaking overnight. If the quantity of pulp is small one may use an electric blender to get smoother consistency.

To convert the pulp into papiermache dough add whitening, or powdered *kharia,* or multani clay (white or pink soft clay available at the general merchants shop) about the same weight as the pulp, and paste (about one third the amount of pulp), and mix thoroughly. The dough is now ready for use. If the pulp is not to be used immediately then it should be kept damp, and stored in an air tight plastic container or bag.

The whiting may be replaced by plaster of Paris or builder's plaster. In this case first mix in the paste. At this stage the dough should not be too stiff or too sloppy. To mix plaster take a little water in a bowl, sprinkle plaster on to it, distributing it evenly. *Do not stir it yet.* Continue adding plaster until it has reached the water surface. Now stir by hand, dissolve any lumps and avoid creating air bubbles. The mixture is now ready for use and should be used at once or else it will begin to harden. (Caution : Do not throw residual plaster of Paris or papiermache with plaster of Paris into the drain. For cleaning pour enough water into the mixing bowl and rinse into a separate container. Allow the sediment to settle. Decant the water and throw away the sediment into the dust bin). Setting of the plaster will be considerably delayed if added to the pulp allowing time for working with it. The papiermache dough is now ready for use.

Work on a piece of cardboard on which the model can rest while being dried. Squeeze some of the mixture into a lump and shape it with your hands, as you would clay or plasticine. Any piece that you add should be firmly pressed into the main form to make sure that they do not come off later. Avoid making any part of it too thin, it may break off on drying. Household things like knives, spoons, forks, ice cream sticks etc. may be used as modelling tools. You may use it to make models on wire and paper framework as described in the method for paper strips alternately use a plasticine or a clay mould. Whenever you are making papiermache for modelling remember to allow for shrinkage.

Papiermache needs a few days for drying depending on temperature. A warm oven will hasten the process.

IV. Finishing papiermache models

Papiermache models, whether made from strips or pulp have a relatively rough surface. In addition the ones made from strips will have the prints and colours showing. The first step to finishing therefore is to cover the surface to produce a smooth finish. This may be achieved with a thick coat of white paint, or thin layer of plaster of Paris or a coating of gesso.

Gesso is a mixture of whiting or plaster of Paris with glue. To make it mix equal quantities of whiting and water. *Do not stir,* as it will lead to the formation of bubbles in the mixture. Leave to stand for a few minutes. Decant off excess water. Add to it half as much glue. Any liquid type of glue may be used but the white synthetic type is best. Add a few drops of linseed oil. The mixture should now be gently stirred avoiding formation of too many bubbles. The final consistency should be like thick cream. If it is too thin add more whiting, if too thick add more water. The gesso is now ready for applying on the papiermache.

The papiermache model should be completely dry before the gesso or paint is applied to give a smooth finish. This will ensure that all shrinkage and cracking is complete before the foundation layer is applied. Allow the white foundation layer of paint or gesso to dry out thoroughly before proceeding any further. Application of this layer has many advantages, it covers up the print, fills in the cracks and provides a smooth surface for painting. Also the white background makes the subsequent colours show up clearly and brightly.

In case of the flat and bowl shapes made from paper strips, the moulding can be strengthened by covering with a piece of cheesecloth dipped in plaster of Paris, or strips of plaster bandage used in binding of fractures. Then the gesso layer may be applied

On this foundation layer most types of paints can be used—water colours, poster colours, acrylic paints, enamel paints, etc. The layer should however be neighter too thik, so as to show the foundation nor too thick. Thick layers of paint may crack and peel off. Water based colours have an advantage that if a mistake has been made it can be washed off without damaging the model. Fresh paint may be applied after drying. The best type of paint to use is acrylic which gives a lasting bright colour.

For a final touch coats of thin varnish may be applied. A coat clear laquer gives a high polish. Wax polish such as used for car and furniture imparts a dull gleam. This final coat whether of varnish, laquer or polish is very necessary to preserve the colour. The model at this stage will be ready for display. □

How Good are You in Science

How good are you in science has been introduced as a regular feature. You can use it for fun or prepare yourself for a test. Score the answers and check up with the given key.

1. Bisexual flower is a flower in which
   (a) only petals are present
   (b) only stamens are present
   (c) only gynaecium is present
   (d) both androceium and gynaecium are present
2. Match the different items of column I to the appropriate items in column II

Column I		*Column II*	
A.	Potato	a.	*Raphanus sativus*
B.	Rice	b.	*Soanum tuberosum*
C.	Wheat	c.	*Oryza sativa*
D.	Radish	d.	*Solanum nigrum*
E.	Lotus	e.	*Triticum vulgare*
		f.	*Nymphaea lotus*
		g.	*Brassica campestris*

3. The correct sequence of cellular growth stages is
   (a) division-differentiation-elongation
   (b) division-elongation-differentiation
   (c) differentiation-division-elongation
   (d) elongation-differentiation-division
4. The site of fertilization in human beings is the
   (a) fallopian tube
   (b) vagina
   (c) uterus
   (d) mesovarium
5. The nose is a
   (a) mechanoreceptor
   (b) chemoreceptor
   (c) thermalreceptor
   (d) cold receptor
6. Trace the path of oxygen from trachea in the following organs in proper sequence
   (a) bronchi
   (b) bronchioles
   (c) alveolar ducts
   (d) respiratory bronchioles
   (e) terminal bronchioles
   (f) alveolar cappillaries
   (g) cell
   (h) tissue cappillaries
7. Of the following groups one does not belong to the group. Locate the odd one.
   (i) A. Tiger, B. Hyena, C. Bear, D. Leopard E. Deer.
   (ii) A. Horse, B. Sheep, C. Buffalo, D. Cow, E. Pig
8. Periderm is
   (a) cork
   (b) cork cambium
   (c) phelloderm
   (d) cork, cork cambium and phelloderm
9. The largest secretory gland in the human body is
   (a) pancreas
   (b) liver
   (c) parathyroid
   (d) adrenal
10. The form and structure of growing cells are maintained because of the
    (a) plamolysis
    (b) turgidity
    (c) wall pressure
    (d) atmospheric pressure
11. A flask was filled with gaseous carbon tetrachloride (CCl_4) and weighed at a measured temperature and pressure. The flask was flushed and then filled with oxygen at the same temperature and pressure. The weight of CCl_4 vapour will be
    (a) same as oxygen
    (b) one-fifth as heavy as oxygen
    (c) five times as heavy as oxygen
    (d) twice as heavy as oxygen
    (e) four times as heavy as oxygen

12. Consider the following statements about a chemical equation and mark the ones that are *true*
    (a) mass is conserved
    (b) molecules are conserved
    (c) atoms are conserved
    (d) moles are conserved
13. Fructose has a molecular weight of 180 and the empirical formula CH_2O. What is its molecular formula?
14. Which of the following combinations is most likely to form predominantly ionic bonds
    (a) oxygen-oxygen
    (b) hydrogen-carbon
    (c) potassium-chlorine
    (d) fluorine-chlorine
15. What will be the molarity of the hydrochloric acid solution produced if 1.62 x 10^4 moles of pure HCl is dissolved in sufficient water to make the volume of the acid 1 x 10^3 litres?
    (a) 1 M
    (b) 8.1 M
    (c) 16.2 M
    (d) 1.62 M
16. Using 'T' and 'F' indicate whether the following statements are true or false
    (a) Copper metal can dissolve in nitric acid liberating H_2 gas
    (b) Nickel can reduce Sn^{+2} to Sn but cannot reduce CO^{+2} to CO
    (c) The nuclei of oxygen atoms have a different number of protons than the nuclei of any other element
    (d) Atoms of oxygen have a higher ratio of neutrons to protons than the atoms of any other element
    (e) The boiling point of sea water rises as the liquid boils away
17. Which of the following statements is equally true for strongly acidic and strongly basic solution?
    (a) Solution turns litmus blue
    (b) Solution has a hydrogen ion concentration of 10^{-7} M
    (c) Solution tastes bitter
    (d) Solution is a very good conductor of electricity
    (e) Solution reacts with Mg to liberate hydrogen
18. Positive ions are formed from neutral atoms by the loss of
    (a) protons
    (b) energy
    (c) electrons
    (d) neutrons
    (e) nuclear energy
19. Which of the liquids mentioned below will have the highest vapour pressure, assuming all of them are at room temperature
    (a) water
    (b) mercury
    (c) honey
    (d) Perfume
    (e) motor oil
20. Which of the following are vector quantities
    (a) a force of 10 N acting South
    (b) a density of 10 Kg/m^3 in Delhi
    (c) a temperature of 10°C at the North Pole
    (d) a velocity of 10 metres per second going North.
21. After recovering from a severe cold, Ram was partly deaf in one ear. Which of these was the most likely cause
    (a) the Eustacian tube was blocked
    (b) the auditory nerves were broken off
    (c) the cochlea had become drained of fluid
22. By what method does heat travel
    (a) from sun to earth
    (b) from the earth's surface to the subsoil
    (c) from the ocean surface to the ocean bed

23. Which of the following statements apply to a magnetic compass
    (a) has the pivot vertical
    (b) has the pivot pin horizontal
    (c) points nowhere in particular at the north geographical pole
    (d) the needle stands approximately vertical at the graphical poles
    (e) enables you to determine whether you are in the Arctic
    (f) would enable you to estimate if you were approximately over the Equator
    (g) gives false reading if placed near a magnet

24. If today 128 g of radium with a half-life of 1600 years what will it weigh 4800 years hence?
    (a) 128 g
    (b) 64 g
    (c) 42.7 g
    (d) 32 g

25. The property of a substance to remain in a new shape after the force ceases to act is called
    (a) elasticity
    (b) plasticity
    (c) fluidity
    (d) brittleness

26. At the sea level the length of the tube of a mercury barometer should be
    (a) equal to 76 cm
    (b) more than 76 cm
    (c) slightly less than 76 cm
    (d) 0 cm

27. Human ear respond to sound frequencies which
    (a) are less than 20 vibrations per second
    (b) lie beeween 60 and 13,000 vibrations per second
    (c) lie beween 20 and 20,000 vibrations per second
    (d) are more than 20,000 vibrations per second

28. When vapour converts into liquid, the heat released is due to
    (a) increase in its potential energy
    (b) decrease in its potential energy
    (c) increase in its kinetic energy
    (d) decrease in its kinetic energy

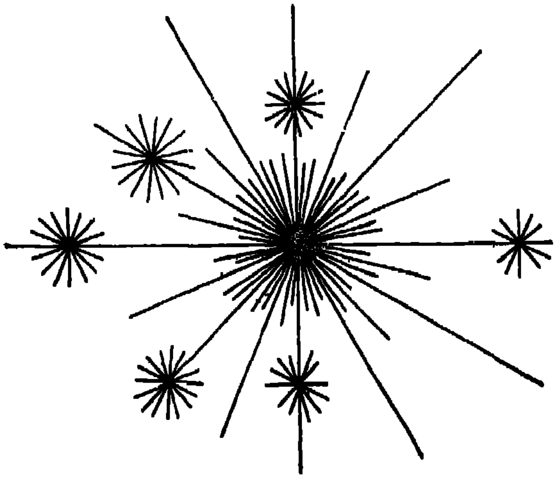
29. Mark the following statements true or false
    (a) The magnitude of inertia possessed by all bodies in nature is the same
    (b) On increasing the length of a pendulum its oscillations become faster
    (c) The standard unit for measuring mass is the kilogram
    (d) All metals are crystalline substance
    (e) The internal energy of the finger of our hand is transfered to water at 45°C when the former is dipped into the latter

30. The phenomenon which best supports the theory that light is a form of transverse rather than longitudinal wave motion is
    (a) reflection
    (b) refraction
    (c) diffraction
    (d) dispersion
    (e) polarisation

S. BHATTACHARYA
NCERT, New Delhi

(For answers see page 47)

Science News



Cosmonauts grow Taller in Space Flight

Soviet cosmonauts Leonid Popov and Valery Ryumin grew taller by 3 cm each during their record six-month space flight. Doctors who examined the cosmonauts on their return to earth found their muscular tissues and cartilages slightly stretched. But after stay on earth for some time Popov and Ryumin will get back to their normal height under the influence of earths' gravitation.

Popov and Ryumin also gained up to 3 kg in weight during their six-month stay aboard Salyut-6. Earlier as a rule, cosmonauts in orbit lost some weight or a few managed to retain their pre-orbit weight. The two cosmonauts also improved considerably the muscular strength of the shoulder belt. Specialists believe that this is due to their rational adjustment of daily routine and systematic physical exercises and gymnastics.

Doctors who examined the cosmonauts said they got the extra centimetres because of conditions of weightlessness during the six-months in space.

A man is a centimetre taller in the morning than in the evening because of compaction of the cartilages of the spinal column and muscular tissue.

Pluto's Atmosphere

Pluto, the planet farthest from the sun in the solar system, has a thin atmosphere of methane, astronomers at the University of Arizona have discovered.

The discovery destroys the theory that Pluto is not really a planet but some other type of body such as a comet. Professor Uwe Fink told the annual conference of the planetary science division of the American Astronomical Association.

The newly discovered atmosphere is the least dense in the solar system, 300 times thinner than that of earth but not too different than that of Mars.

Asteroid may not Hit Earth

The nearst approach an asteroid will make with the earth in the near future will be in 1992 when Geographos will come near the earth, according to Dr. Narendra Bhandari, a noted space scientist. Engaged in the study of lunar rocks and meteorites at the physical research laboratory here, Dr. Bhandari said the asteroid is unlikely to hit the earth. But, if it did come too close, modern space technology was sophisticated enough to deflect it away.

The previous such phenomenon occurred 65 million years ago, or 63 million years before the emergence of the human race and had resulted in the extinction of many life forms. Among the animals and insects killed in the resultant global explosion were flying reptiles, sea organisms and the species of dinosaur, a four-footed animal larger than an elephant in size and having two brains, one in the head and the other in the spine, Dr. Bhandari said.

Sun Powered Refrigeration

An intermittent solar refrigeration system has been designed at the Indian Institute of Technology, Delhi for refrigeration during early hours of the day. Suitable for the tropics, the system does not need electricity and is fit to be used in any part of the country. The system is capable of attaining temperatures as low as minus 15° Centrigrade with ordinary flat plate solar energy collectors.

The system has great potential in countries like India having an abundant supply of solar energy. By completely eliminating high grade energy like electricity, the system employs absorption refrigeration techniques and is solely operated by solar energy. The refrigeration system consists of a solar energy collector, a storage unit and an absorption unit.

IIT has also designed a continuous refrigeration system. It is a one-tonne aqua-ammonia refrigeration plant designed for low-temperature applications.

Moon Rock Analysis

Research of a dozen lunar samples obtained from the USA and Russia has revealed that a lunar rock is completely fragmented in periods of 10 to 15 years because of high energy and micrometeorite impacts. As a consequence of this mechanism, the research further reveals, the dust is also continuously reworked and a phenomenon akin to gardening of surface soil takes place.

The Physical Research Laboratory, Ahmedabad, is conducting the lunar sample research for the last six years with assistance from the National Aeronautic and Space Administration (NASA) and the USSR Academy of Sciences. These agencies provided the rock and dust samples of the moon that were brought by the Luna and Appolo flights.

There are three proposals, two with NASA and one with the USSR agency. One NASA proposal is for study of solar and galactic cosmic ray records based on their effects in lunar samples. Work on this study is nearing completion, Professor Narendra Bhandari, principal investigator for this study, said.

Meanwhile, research by Japanese scientists have shown that Moonquakes—the moon's equivalent of earthquakes—are apparently caused by the earth's gravitational pull. Mr. Jungi Koyama of Tohoku University, told a conference of seismologists in Sendai, Japan, that the majority of quakes on the moon in past years occurred when the earth and the moon were closest and thus the earth's gravitational pull on the moon the strongest. Mr. Koyama said that the earth's pull is also causing slight distortions in the moon's shape from round to oval. This effect is concentrated at a depth of around 900-1,000 km causing the moon's structure of solid rock to break up.

Magic Particle that solves Problems

A chemistry professor at Allahabad University claims to have synthesized a unique particle which he says will help end the energy and fertilizer crisis. Dr. Krishna Bahadur said that the particles can split water into oxygen and hydrogen in the presence of sunlight. Hydrogen which can replace oil and natural gas is considered the fuel of the future. He says the same particles, with the help of sunlight, can convert nitrogen in the air into fertilizer and thereby rid the fertilizer industry of its dependence on naphtha.

The miracle particles synthesized by Dr. Bahadur and his wife Dr. S. Ranganavaki, also a chemist have been named "Jeevanu" meaning "particles of life". "These are cell-like particles about three thousandths of a millimetre across. They grow and multiply in test-tubes and, like cells, have distinct boundary walls. They are not real cells, but are in the borderline between living and non-living. Jeevanus mixed with water liberate about 100 litres of hydrogen a day from one square metre area exposed to sunlight. They were synthesized in the laboratory several years ago and over 50 papers on the properties of this unique particle had been published by his team. But only recently, in the wake of the energy crisis was jeeanus use in splitting water studied".

Dr. Bahadur's claim was first made at a symposium on "alternate energy" recently by the National Academy of Sciences. But scientists attending the symposium dismissed the claim.

He says now his work has been confirmed by Dr. D. O. Hall of King's College of London University. Dr. Adolph Smith of Ames Research Centre of the US Space Agency NASA, Dr. Clair Folsome of Hawaii University's Laboratory for Primordial Biology and Dr. M. G. Briggs, another British biologist.

Dr. Bahadur said jeevanu is akin to the "protocell that evolved on earth 3.5 billion years ago and was the precursor to the modern living cell. It was the protocell which with the help of sunlight, produced hydrogen by splitting water of the oceans. The hydrogen in turn changed the carbon dioxide and nitrogen into forms that easily combined to make amino acids and nucleic acids found in modern cells.

Radar to tell Shape

Two US navy scientists have discovered a technique to use radar or sonar to identify a distant target, not just tell how far away it is. The discovery may have far-reaching potential in medicine, the search for oil and other fields as well, they say. The technique, based on methods first used in nuclear physics, provides a methematical way to learn something about the shape and composition of an object by reflected radio waves, sound waves or any other kind of waves. The method devised by Mr. Herbert M. Uberali and Mr. Guillormo C. Gaunaurd of the Naval Surface Weapons Laboratory at Silver Spring, Maryland, may enable scientists to read an object's distinctive "signature" in its returning echo.

In military uses, the technique offers a possible solution to the problem of distinguishing enemy from decoy.

It might, for example, be used to tell whether an underground pool was composed of oil or water or whether a suspicious mass in the brain was fluid or tumorous, Mr. Gaunaurd said.

Test-Tube Antibodies

Scientists have performed a genetic engineering feat by fusing cells of different kinds to produce "antibodies" in test-tubes—outside the human body.

"Antibody" is the substance the body makes in response to vaccination to protect a person against infection. The new genetic method enables production of huge amounts of specific antibodies in "test-tube factories".

The technique of making antibodies in test-tubes, initially developed abroad in 1975, has now been demonstrated by a team of biochemists led by Professor G. P. Talwar at the All India Institute of Medical Sciences in New Delhi. The technique involves "fusing" the genes of an antibody forming cell into a cancer cell (Myeloma cell) which has the ability for rapid growth. The hybrid cells thus formed (called Hybridoma) are cultured in test-tubes where they work like antibody factories.

By using the "Myeloma" cell with the antibody making cell from the spleen of mice, Professor Talwar and his team has produced antibodies against HCG (Human Chlorionic Gonadotropin)—a hormone produced during pregnancy and in certain types of cancer.

The HCG-antibody manufactured in test-tube, can be used to develop simple "kits" to diagnose pregnancy and cancer. It may even be possible, according to Professor Talwar, to use these antibodies to terminate pregnancy.

Hope in Cancer Screening

Early detection of breast cancer can reduce the risk of death from the disease by almost a third, a new survey claims. Of 47,000 women screened for breast cancer at the British United Provident Association medical centre in London, which celebrated its tenth anniversary last week, more than 200 cases were diagnosed.

The centre announced that more than 70 per cent were alive and healthy six years after diagnosis, compared with less than 50 per cent of the average unscreened women. Early detection had been made possible by the development of X-ray diagnosis (mammography) with a very low radiation dosage. The centre claimed that if the tumour was detected by X-ray alone, that is, before a lump could be felt, the outlook for a complete cure might be 100 per cent.

Dr. H. Beric Wright, deputy chairman of the BUPA medical centre, said : "Breast cancer is still the biggest killer of middle-aged women, although it is rapidly being caught up by lung cancer and ischaemic heart disease. For women aged 45-54 death rates a million in 1960 were 569 for breast cancer, 321 for ischaemic heart disease and 96 for lung cancer. The corresponding figures for 1976 were 648, 510 and 267 deaths a million. The only hope for improving the outlook for breast cancer victims lies in early detection and simple local surgery. The medical centre has played a great role in developing the technology of X-ray diagnosis".

Ultimate X-Ray Machine for Cancers, Heart Defects

An X-ray machine, one that could find tiny cancers or heart defects long before they cause trouble, is now being built at the giant Mayo Clinic, Rochester.

The machine a 17-ton device will whirl 28 X-ray machines around a patient to make thousands of images a second. The images will be fed to a computer to reconstruct any part of the body. In a period of a few seconds, with no more X-ray exposure than a few chest X-rays, the machine will electronically slice open any part of the body or any organ in any direction, transfer a series of images to magnetic tape and display them on a TV-like screen for immediate or leisurely examination.

The picture will show the organ in three dimensions almost as if a surgeon had removed it. The machine can also display the organ's interior, as if the surgeon had then cut it open. Such organs as the heart blood vessels and lungs will be seen at work, with blood and oxygen flowing through them. It resembles not an ordinary X-ray machine but a big electric turbine or perhaps some sort of science-fiction creature-freezing machine. The patient or in current tests, an animal subject is wheeled inside the machine. The principle then used, one to convert X-ray images into electronic bits which are then re-assembled by a computer, is the same one that last year won Nobel prizes for the scientists who developed "CT" or "CAT" scanning. CAT (for "computer-assisted tomographic") scanners are already in use in hospitals. With only one X-ray machine, they can examine the body only in horizontal sections. In contrast, the DSR dices up the body like a cook dicing a chicken, then puts the cubes together mathematically and electronically so doctors may "call up" any view. "A portion of the body will be just sitting there in space", Dr. Lowell Harris explained recently, "You will be able to walk around it, look at it, see the organs life-size and in motion (and) manipulate them".

Whether or not this new body reconstructor becomes a standard tool, it is certain to yield new knowledge of heart and blood vessel and other physiological action. But Mayo scientists see many everyday diagnostic possibilities such as providing far more accurate information on heart muscle damage after a heart attack.

"Because it can look inside the body from any angle", Dr. Earl Wood, clinic scientist added, "that the machine should "find" a small lung tumor which otherwise would be hidden behind a rib in a conventional X-ray".

Vitamin 'A' reduces Cancer Risk

British scientists reported a study showing that low levels of vitamin 'A' in the body are associated with increased risks of cancer. The scientists wrote in the medical journal 'Lancet' that the study of 1,600 men showed that those with the lowest levels of vitamin 'A' were exposed to more than twice the risk of cancer than those with the highest levels.

They said the study indicated there might be hope of reducing cancer risk by dietary change but did not suggest any specific diet. However, beef liver, butter, margarine, spinach and carrots are known as good vitamin 'A' sources. The study was conducted between 1975 and 1979 on men and aged 35 to 64 years. Age and smoking habits were taken into consideration.

Pests Proliferation and Solar Activity

Soviet scientists have been able to forecast the beginning and the end of a new outburst of mass scale reproduction of agricultural pests on the basis of the effects of solar activity on them. Scientists from the Ukrainian Republic have made studies of 20 species of pests, which effect the agricultural crops in terms of their yield.

Comparing the results of observations of the reproduction of these insects over the past 50 years with the information on the intensity of solar radiation, they succeeded in establishing the patterns of their active propagation.

New Kidney Technique

Kidney patients' lives are being transformed by a new development in a treatment which frees them from the need to be connected to a machine for 18 hours a week. Doctors testing the treatment at the Royal Victoria Infirmary, Newcastle upon Tyne, think it could provide an answer to the shortage of kidney machines and kidneys for transplantation. It is cheaper than using a machine, and gives patients greater mobility and a less restricted diet.

A solution is infused from a plastic bag into the peritoneum, the membrane covering the abdomen, over a half-hour period. It remains there for four to six hours while blood impurities are drawn into the solution. The patient, who has a thin plastic tube permanently fixed in his abdomen, then empties the solution back into its plastic bag, disconnects the bag and starts the process again with another bag. At night the solution can remain in the abdominal cavity for eight hours.

The process differs radically from haemodialysis, which immobilizes the patient for about three six-hour sessions a week. Dr. Karl Nolph, Chief of the nephrology division of the University of Missouri Medical Centre, where patients have been using the technique for four years said, "it is a very slow, gentle process".

Contact with a Nicobar Tribe

The Mongoloid tribe of Shompens which lives in thick tropical forests of Great Nicobar was contacted for the first time in recent years when a party of census officials led by a Deputy Director, Mr. S. P. Sharma, visited a Shompen village over 40 km by sea from Campbell Bay town.

There were only two huts with 15 Shompens —six women, five men and five children. They resembled traditional Nicobarese huts built on 4 to 10 ft high poles. The houses looked very dirty and foul smelling. Pigs and dogs were being treated like members of the family.

The Shompens, including children and women, are in the habit of chewing tobacco leaves and betelnuts almost constantly and their teeth are badly affected. Because of this all of them have skin ailments. The headman of the village is sturdy and well-built. He has two wives and four children all living in one room—which is living room and kitchen. The younger male Shompens are also well-built. All of them are experts seafarers and frequently visit Campbell Bay in canoes built by themselves. Their food includes fish, pork, turtles and worms grown on decayed barks of a particular tree. The Shompens were presented with gifts of buckets, knives, clothes and tobacco leaf by the census party.

Another village called Badduan was located deep inside the jungle on the upper bank of the Gelathia river. But there were no Shompens in the village as they had left when they came to know that an outside party was to visit them.

Bringing the Birds into Survival

Only five Chatham Island black robins remain—three females and two males—on their last refuge, Mangere Island in the Chathams group 800 km offshore. No bird species has ever been known to survive once its number has dropped so low. But the New Zealand Wildlife Service is trying to build up the number of robins using a technique never tried here before known as transfered hatching.

A last desperate attempt to save one of the world's rarest birds from extinction is being made on a small, bleak island east of New Zealand. In this technique, the first batch of eggs each season is transfered to the nests of other bird species in the hope the endangered birds will lay a second clutch. It has been used successfully in other countries.

The Wildlife Service is pinning its hopes for the black robins' survival on this technique in an effort to increase the birds' productivity. These officials are on the island waiting to see if the birds will nest during the southern hemisphere spring. If so, they will 'paid' the nests and transfer the eggs to nests of warblers and hedge sparrows. The Service said the robins usually nest if they lose their first clutch and the birds will be left to raise their second broods undisturbed.

It is highly unlikely that numbers would increase by natural means given the number of birds and the island's cold climate. The species, one of four robin varieties in New Zealand, had long been found only on Mangere Island. The Chief Wildlife Officer, Mr. Peter Fisher said New Zealand has a poor record of saving endangered birds during the 200 years since European settlers first arrived. Ten to 15 species have probably become extinct in the last century alone. But recent conservation efforts have been good.

He named two other species in serious danger—the black stilt, with 50 to 60 known individuals left, and the kakapo with numbers estimated "between 20 and 100" and steadily declining. The Service is monitoring the kakapos closely and has located several females this year.

As for the black stilt, 11 eggs were saved from floods and dust-storms last year and all were hatched in an incubator. It is planned to use some of these birds as a nucleus of captive breeding stock. One species listed as probably extinct—the orange breasted parakeet—was sighted again after a 15-year lapse.

Origin of Decimals in Harappa

The noted archacologist, Dr. S. R. Rao has proffered a new theory that it was the Harappans who bequeathed to the world the decimal system of measurement, the use of gold as a medium of exchange and the science of yoga. Opening the Alur Venkata Rao Foundation, Dr. Rao said he had found that the Harappans produced gold discs which ran in a particular ratio of weight, the unit known as "gunja", conforming to the "Suvarna Mashaka" referred to in Kautilya's Arthasastra

Gold discs of various sizes found at Lothal and hitherto mistaken for pendants weighed 50 m.gram, 100 m.gram, 2,400 m. gram, 2,750 m. gram, 2,800. m. gram, 2,900 m. gram, 3,000 m. gram and 3,250 m. gram, thus giving a decimal system.

Mr. Rao claimed that it was the Harappans who introduced the decimal system for linear measurement and for weighing objects like gold and precious stones. The divisions marked on the Lothal ivory scale in decimal system were the smallest known in the ancient world, for each division measured 1.7 mm. Though the scales found at Harappa, Mohenjodaro and Lothal were all differently marked they were interrelated, he said.

The vast structures such as the cockyard at Lothal were well proportioned in terms of the Lothal linear scale. The Harappan measurement system was continued in later days. The 10 divisions on Lothal scale were equal to the "Angula", mentioned in the Arthasastra, he said. The Harappans achieved "great accuracy" in the measurements of fundamental units of length, mass and perhaps time also. The smallest unit of length was 1.7 mm and of mass 50 mg.

The fact that the Harappans performed periodical sacrifices similar to the "Gavamayana" showed that they were trying to measure time and determine the seasons. The Harappan gods depicted on seals in yogic postures and the terracotta human figures also modelled in yogic poses showed that they were pioneers in practising yoga.

ANSWERS OF "HOW GOOD ARE YOU IN SCIENCE"

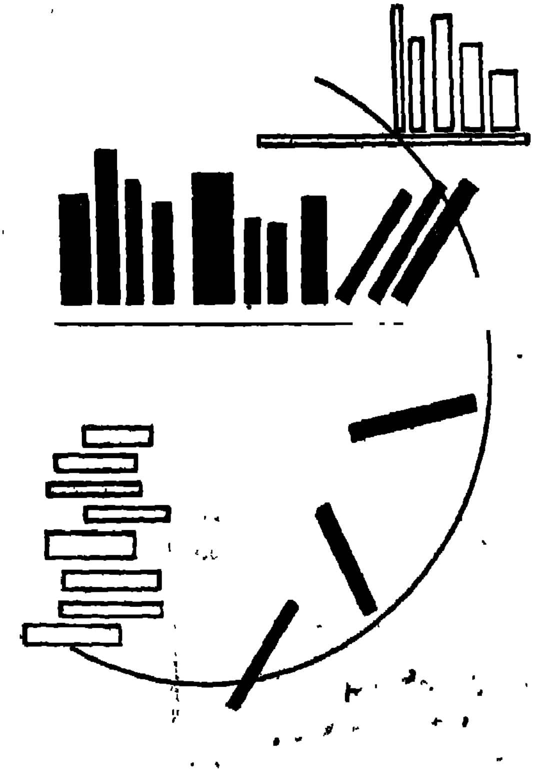
Answers:

1(d); 2 A(b), B(c), C(e), D(a), E(f); 3(b); 4(a); 5(b); 6(a, b, e,d,c, f, h, g); 7(i)E, (ii) A; 8(d); 9(b); 10(b); 11(c); 12(a & c); 13 $C_6H_{12}O_6$; 14(c); 15(c); 16(a) F, (b) T, (c) T, (d)F, (e)T; 17(d); 18(c); 19(d); 20 (a & d); 21(a); 22(a) radiation, (b) conduction, (c) convection; 23(a, c, g); 24(d); 25(b); 26(b); 27(c); 28(b); 29(a)F, (b)F, (c)T, (d)T, (e)F; 30(e).

Book Review

Biological Revolution and Human Welfare

DR. T. SANKARAN, *Transaction No. 54, Indian Institute of World Culture, Banglore 1980, pp. 12.*



THE TREMENDOUS growth in the applications of biological knowledge in the last few decades and its felt impact on the society to bring about the alround welfare of mankind are known to many of us, if not all. The transaction under review, which highlights the foregoing statement, is the outcome of the fifth J. Srinivasan Memorial Lecture delivered at the Indian Institute of World Culture, Bangalore Dr. T. Sankaran, an eminent biologist and a Fellow of the Royal Entomological Society of London, was the speaker. Dr. Sankaran, Chief of the Commonwealth Institute of Biological Control, Indian Station, Bangalore under Commonwealth Agricultural Bureaux is one among the very few contemporary Indian biologists who are internationally known for their outstanding contributions.

In the present transaction the author has briefly presented the story of explorations of the biological facts and phenomena during the ancient and medieval period, the subsequent ramification of the subject into several branches, its intra- and inter-disciplinary interplay in terms of new discoveries and their impacts, the revolutionary growth of various branches of biology with the passage of time culminting into recent breakthrough in the frontiers of agricultural, microbial, medical and molecular biology. Within the limited pages of this transaction he has duly emphasized how man has continuously been capitalizing the fruits of biological revolution in its entirity for his own welfare that had and has been continuing on the earth.

Contents of the transaction have been covered under the broad headings—'Ancient and

Medieval Biology', 'Modern Biology', 'Biology in Food Production', 'Microbial Technology', 'New Era of Research', 'Role of Biology in Medical Progress', 'Molecular Biology', 'Revolutionary Changes', 'Cultural Value' and 'Ecology and Evolution'. All these sections are well written, though at places the contents under some sections are considerably disjointed.

Sections under headings 'New Era of Research' and 'Molecular Biology' need special mention from the point of view of treatment and coverage of contents on the recent revolutionary trends in the fields of applied entomology and molecular biology respectively. Problems posed by the indiscriminate use of pesticides and insecticides, ecological imbalances and methods of biological control of insects and pests and their future prospects have been properly discussed with suitable examples under 'New Era of Research'. While discussing the possible future development of molecular biology in general and genetic engineering in particular in terms of human welfare the author has aptly quoted the remarks made by Peter Farley, president of a new corporation organized to capitalise on recombinant DNA's potential : 'There has been a golden age of chemistry and golden age of physics. Now it is biology's turn'. Contents under molecular biology traces the growth of this specialised and sophisticated branch right from the early days of research on DNA to recombinant DNA, artificial synthesis of the gene and living cell and the scientists' aspiration to seed the planet Mars with artificially created life forms.

If the contents of this transaction is propedly elucidated and expanded this will surely transform into a good book and draw interest of biologists, students and teachers of other disciplines as also the enthusiastic lay readers.

JAGANMAY MITRA
Reader in Zoology
DESM, NCERT, New Delhi